Synthesis report of existing legal, policy and science approaches in relation to DRR and CCA (Deliverable 2.1)

National Report - Denmark

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Publication date:
2017

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(Deliverable 2.1)

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 700342. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein

Acknowledgments

The following institutions and individuals have directly contributed to the ESPREssO project. We hereby acknowledge the valuable input of these organisations and individuals in contributing to this report.

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List of Acronyms

CCA- Climate Change Adaptation

DRR- Disaster Risk Reduction

TBCM-Transboundary Crisis Management

SFDRR- Sendai Framework for Disaster Risk Reduction

SDGs-Sustainable Development Goals

EU- EuropeanUnion

DG ECHO- European Civil Protection And Humanitarian Aid Operations

DG CLIMA-Climate Action EuropeanCommission

DG ENV- DG Environment

DG DEVCO- International Cooperation and Development

EEA- European Environment Agency

ICCG-International Centre for Climate Governance

EPCIP- European Programme for Critical Infrastructure Protection

UNECE- United Nations Economic Commission for Europe

EFAS- European Flood Awarness System

List of Definitions

Disaster

The term 'Disaster' is defined as a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UNISDR, 2007). In general, disasters can be categorised into two main types: natural disasters and manmade disasters (Brun, 1992). The origins and causes of these disasters may differ, but the consequences are more or less same, which include loss of lives, economic losses, destructions to the built and natural environment, and disruption to the local institutions and livelihoods (Haigh and Amaratunga, 2010).

Natural Disaster

Natural disasters can be classified as geophysical disasters, hydrological disasters, metrological disasters, climatological disasters, biological disasters, and extra terrestrial disasters. Geophysical disasters include earthquakes and volcanic activities. Hydrological disasters include floods and landslides. Metrological disasters include storms and tropical cyclones. Climatological disasters include, droughts and wildfires. Biological disasters include animal attacks and epidemics. Extra-terrestrial disasters include impacts and space weather (Guha-Sapir et al 2016).

Disaster Risk

UNISDR (2007) defines disaster risk as the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period. Further, disaster risk can be identified as the expectation value of losses (deaths, injuries, property, etc.) that would be caused by a hazard. Accordingly, disaster risk can be seen as a function of the hazard, exposure and vulnerability (Kitamoto, 2005).

Hazard

A hazard is a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (UNISDR, 2015c).

Vulnerability

vulnerability is the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard (UNISDR, 2007).

Exposure

'Exposure' is the third component which creates disaster risk, and refers to that which is affected by natural disasters, such as people and property (Kitamoto, 2005).

Disaster risk is an outcome of these three key factors and the integrated effect of these three factors can be identified as the mechanism behind the emergence of natural disasters. Figure 1 illustrates the mechanism behind the emergence of natural disasters.

Disaster Risk Reduction

DRR refers to a wide range of opportunities for risk abatement and disaster management. Risk reduction includes prevention, preparedness, and part of the recovery process, and it gives particular emphasis to the reduction of vulnerability (Ammann, 2013, Alexander, 2013).

Climate Chanage Adaptation

The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities (IPCC, 2012).

1 Executive Summary

This report is a summary of the existing legal/policy and science approaches to natural hazards and CCA. The report offers three perspectives: national, EU-wide, and global.

Legal/policy and science approaches play a key role in DRR as well as for CCA. Lega/policy and science approaches provide the necessary legal and scientific mandate for CCR and DRR initiatives to begin, proceed and succeed.

This report is an output of the ESPREssO project (Enhancing synergies for disaster prevention in the European Union) that aims to contribute to a new strategic vision for natural risk reduction and CCA, thereby opening new frontiers for research and policy making.

This report draws upon the findings of an global review, an EU-wide review and six national reports developed for Italy, Germany, France, Switzerland, UK and Denmark. The study involved three phases, beginning with a literature review to identify the key challenges and gaps related to the integration of DRR and CCA, science vs legal policies in DRR, and transboundary crisis management, and the development of a conceptual framework. Phase 2 involved a content analysis approach to analyse available legal/policy and science approaches in different context. Phase 3 involved a desk-based literature review, semi-structured interviews, focus group discussions and an online questionnaire survey.

The findings illustrate the key global, European and national policies in relation to DRR and CCA.

The key global policy for DRR is the SFDRR 2015-30, whereas for CCA it is the Paris Climate Change agreement, although both make reference to the need for convergence. The SDGS addresses both DRR and CCA, while also stressing the importance of integrating DRR and CCA to support more sustainable development. These global policy frameworks have created a significant opportunity to build coherence across overlapping policy areas. It is expected that these global agreements provide a foundation for a shared aim of making development, sustainable, resilient and safe. However, there are challenges in implementing these global agreements. The key challenge is how these policy commitments are put into practice at the regional and state level. In order to achieve the goals of the global agreements, it is important that these global agreements are integrated. Identifying the synergies between policies, programmes and institutions are important in order to align the actions. Raising awareness on how the different frameworks align, facilitating key partnerships to work across agreements, instituting clear governance arrangements for collective action and accountability, developing consistent definitions, promoting science and technology involvement, joined up monitoring processes and ensuring national ownership and leadership on all the frameworks are some of the strategies to integrate these key global policies at the regional and state.

In the EU, there are several key central EU actors for both DRR and CCA. DG ECHO is a key actor in the EU to provide protection and help to victims of disasters and conflict, both natural and manmade within and outside the EU. EU has comprehensive laws and policies on DRR nd CCA . For example for DRR, the revised EU's Civil Protection Mechanism (CPM) integrates all aspects needed for a comprehensive disaster management policy: disaster prevention, disaster preparedness and improved response arrangements. For example for CCA, EU has the European Union's Climate Change Adaptation Strategy. This sets out several measures on adaptation. Up to date, 15 EU member states have adopted an adaptation strategy. In addition, EU is a follower of the key global agreements. For example, in June 2016 the European Commission launched its action plan to follow up on the recommended policies set by the SFDRR. This action plan covers a five-year period, and offers specific tasks on risk knowledge, risk investments, disaster preparedness and resilience.The European Commission carries out regular reviews and assessments of the action plan to track progress within EU Member States, civil society and the private sector.

Nationally, across the six nations, there are various legal/policy and science approaches focusing on DRR and CCA. Some of the examples from the six countries are, Law 996/1970 is the first Italian regulation for DRR defining an overall framework of civil protection interventions. This law considered the emergency phase and outlined an embryonic system of civil protection organised by the National Fire and Rescue Service. In regards to CCA, Italy has the national strategy on adaptation to climatic change. The Italian Ministry for the Environment Land and Sea is responsible for the adoption of the national strategy. Germany has the Federal Civil Protection and Disaster Assistance Act for DRR which established a legal basis for the fact that the whole of society shares responsibility in case of large scale damage that crosses the borders of federal states. For CCA, Germany established the strategy for adaptation to climate change in 2008 which is a framework for a medium-term national adaptation process. In France, there is General Directorate for Civil security and crisis management for DRR which is in charge of the preparation and implementation of emergency measures that are necessary to population safeguard. As the key policy on CCA, French government introduced the National Strategy on Climate Change Adaptation in 2013 which was completed by a National Plan on Climate Change Adaptation for 2011-2015. It is followed by the National Observatory of the Effects of Climate Warming. Switzerland has established the Federal Office for the Environment which is responsible for water-related disasters such as floods and debris flows, landslides, rock fall and avalanches. Storms and forest fires as well as coordination of the federal earthquake mitigation program. For climate-related and meteorological hazards, such as heatwaves or cold snaps Swiss government has established the Federal Office of Meteorology and Climatology. In 2004 the government of the UK introduced the Civil Contingencies Act which provides a coherent framework for emergency planning and response ranging from local to national level. For CCA, the government of the UK introduced the Climate change Act which is a legislative framework for both climate change adaptation and mitigation. Danish Emergency Managment Act 1992 is the present legal framework for disaster risk management. For CCA, Danish government introduced the Climate Change Adaptation Strategy in 2008. This document outlined a range of policy options available for municipalities in implementing CCA in Denmark.

Lots of gaps in the existing legal/policy and science approaches were identified and these have created different issues for effective management of natural hazards and CCA.

Institutional barriers are identified as a key challenge that hinders the process of successful integration of CCA into DRR. In most of the countries climate change related policies and decisions are made by the ministries and organisations related to the environment, whereas disaster management and reduction decisions are made by ministries related to infrastructure development. This institutional structure disturbs the communication process which generates an information barrier among the institutions. Integration of CCA and DRR is not a legal mandate in most countries. Many have legal provisions for civil protection as a mandate of DRR. Therefore, countries have short term plans for DRR or plans for disaster response and recovery, rather than a long term strategic plan to reduce disaster risk by integrating CCA.

Most countries do not have a specific legal or policy background for the allocation of funding for CCA and DRR. Accordingly, there are funding coming from different sources but it is not equally allocated for CCA and DRR. In addition, in most countries, the political will is greater towards socio-economic development rather than for CCA or DRR. As a result of this, there is less motivation to integrate CCA and DRR.

The effective integration of CCA with DRR requires the participation of a wide range of stakeholders: policy makers, private firms, scientists, NGOs, and educators. Multi-stakeholders and multi-sectoral processes are vital in building common understanding, commitment and consensus. However, coordination of these different stakeholders with different interests is one of the challenges in integration due to an inability to reach consensus on specific adaptation measures .

Procedural gaps and legal frameworks is an issue to integrate CCA and DRR, enabling science for the policy as well as for transboundary crisis management. Further, it was discovered that having a common perception on risk is extremely important for the integration of CCA and DRR. In regards to risk assessment, key issue is the standardisation of risk assessment and completing the risk assessment for all social economic infrastructure.

Effective communication between CCA and DRR communities, academic community and practitioners and practitioners and general public are extremely important for effective integration of CCA and DRR.

2 Introduction

Global demographic trends imply that more people are living in areas vulnerable to sudden-onset natural disasters. Scientists forecast that the frequency and intensity of these disasters are likely to increase as a result of the effects of climate change. These trends, coupled with recent high -profile mega- disasters, are raising global awareness of the need to build the capacity of national governments, civil society organisations and international actors to prevent, respond to and recover from natural disasters (Ferris and Petz, 2013). There is growing recognition that the theory and practice of CCA and DRR are converging, and there is increasing interplay between the two fields (Solecki et al., 2011). Birkmann and von Teichman (2010) highlight that there is a need for a systematic linkage between CCA and DDR to advance sustainable development.

Whether its CCA or DRR, legal, policy and science approaches play a key role in tackling their related challenges. Legal and policy approaches act as the backbone for effective DRR and CCA. Palliyaguru et al. (2010) describe that it is extremely important to integrate DRR policies into the development process. As they specify, risk-management policies, relevant guidelines, standards and legal frameworks should be directly integrated into the National level strategies. Simialry, Burton et al. (2006) state that CCA must be guided and supported by national policies and strategies and for some countries, these, in turn, need to be facilitated through international measures. In this context, Sendai Framework for DRR, Paris Agreement for Climate change have become important global agreements.

Accordingly, this report reviews the existing legal, policy and science approaches in six EU countries, across the EU as a whole, and globally. It identifies the available legal, policy and science approaches that address natural hazards and CCA, and reviews the key issues that prevent more effective integration. The findings of this report are relevant to global and national decision makers that are responsible for the development and implementation of DRR and CAA strategies.

2.1 ESPREssO project

This report is one of the outputs of the ESPREssO project (Enhancing synergies for disaster prevention in the European Union) that aims to contribute to a new strategic vision for natural risk reduction and CCA, thereby opening new frontiers for research and policy making.

To achieve this goal, the project focuses on three main challenges:

- to create more coherent national and European approaches on DRR, CCA and resilience strengthening;
- to enhance risk management capabilities by bridging the gap between science and legal/policy issues at local and national levels in six European countries;
- to improve the management of trans-boundary disasters.

The main final products of ESPREssO will be the Guidelines on risk management capability and a Vision Paper on future research strategies in order to better define the research priorities following the SFDRR 2015–2030.

This synthesis report is a key deliverable of the project, and it reviews the existing legal, policy and science approaches nationally, across the EU and globally in relation to DRR and CCA.

This 30 month project is coordinated by the AMRA Centre, Italy with the participation of six other key institutions from France, Germany, Switzerland, the UK and Denmark.

Further information about the project can be found at www.espressoproject.eu.

2.2 Horizon 2020

Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billions of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market. Horizon 2020 is helping to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation.

2.3 Methodology

This report draws upon the findings of a global review, an EU-wide review and six national reports developed for Italy, Germany, France, Switzerland, UK and Denmark. Table 1 provides details of the institutions that led the development of these separate input papers.

Table 1-Lead Contributoires for input reports

Input Papers	Lead Contributors
National Reports	
Italy	AMRA - ANALISI E MONITORAGGIO DEL RISCHIO AMBIENTALE SCARL
Germany	HELMHOLTZ ZENTRUM POTSDAM DEUTSCHES GEOFORSCHUNGSZENTRUM DEUTSCHES KOMITEE KATASTROPHENVORSORGE E.V.
France	BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES
Switzerland	EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH
United Kingdom	THE UNIVERSITY OF HUDDERSFIELD
Denmark	KOBENHAVNS UNIVERSITET
EU review	KOBENHAVNS UNIVERSITET
Global Review	THE UNIVERSITY OF HUDDERSFIELD

Although each national report was developed and written by a local, in-country team (Table 1), data collection and analysis was coordinated to ensure consistency. This was achieved through regular review meetings and the use of standard protocols and templates. Further, The national reports represent the findings based on the samples of data that was collected by respective espresso project partners and thereby do not necessarily reflect the overall county perspective. A detailed presentation of the data collection and analysis carried out for each country can be found in the respective national reports. Below is a summary of the overall methodology.

The methodology was carried out in three phases. Phase 1 consisted of a literature review to identify the key challenges and gaps related to the integration of DRR and CCA, science vs legal policies in DRR, and transboundary crisis management. Using these initial findings, a conceptual framework was developed to identify key themes for the study. From the conceptual framework, data collection instruments and reporting templates were developed for the national, EU and global perspectives.

During phase 2, a content analysis approach was carried out to analyse available legal/policy and science approaches in the six countries (Italy, Germany, France, Switzerland, UK and Denmark), across the EU and globally. The focus was specifically to identify the key legal/policy and science approaches in relation to DRR and CCA. This phase set out the current status of the legal/policy and science approaches, and a situational analysis.

During phase 3, a desk-based literature review and semi-structured interviews were used to identify the key challenges and issues in the existing legal/policy and science approaches from a national, EU and global perspective. In addition to the desk-based literature review and semi- structured interviews, focus group discussions and an online questionnaire survey were carried out for the global review.

Table 2 demonstrates the key primary data collection instruments and the number of respondents.

Based on the data analysis, mind maps were developed for certain input reports and some of them are presented in section 4 as part of the findings.

Table 2- primary data collection instruments and the number of respondents

Type of Review	Number of Semi-Structured Interviews	Number of Focus Groups	Questionnaire survey responses
National Reports			
Italy	4	-	-
Germany	13	-	-
France	20	-	-
Switzerland	07	-	-
United Kingdom	15	-	-
Denmark	12	-	-
EU review	10	-	-
Global Review	10	3 (with 6 or 5 participants each)	198

2.4 Structure of the report

The remainder of the report is structured as follows:

Section three provides a synthesis of existing legal/policy and science approaches in relation to DRR and CCA. It addresses a global, an EU-wide, and six national perspectives: Italy, Germany, France, Switzerland, Denmark and the United Kingdom.

Section four identifies some of the key issues and challenges associated with legal/policy and science approaches in DRR and CCA, including those which may hinder more effective integration, and their ability to reduce disaster risk.

Section five summarises and brings together the main areas covered in the report, and discusses some of the emerging issues. It also sets out the next phase of the study.

3 Existing legal/policy and science approaches

This section reviews the existing legal/policy and science approaches related to CCA and DRR. This review has three subsections: global, the European Union, and national.

3.1 Global

Disasters, either natural or man-made, cause widespread damage and losses around the world every year. Worldwide, an increased intensity in disasters has been observed over past two decades resulting in a higher number of mortalities, economic and social losses. Particularly, there is an increasing exposure of economic assets, in hazard prone areas which increase disaster risk (UNISDR, 2015d). According to new calculations, natural disasters around the globe have resulted in economic losses of approximately $7 trillion since 1900 (Amos, 2016). Meeting the cost related to natural disasters has increased from US$ 50 billion a year in the 1980s to US$200 billion a year in the last decade (Georgieva, 2014). As such, the annual losses of disasters are staggering. Over the 1900-2015 period, around 40% of economic losses are due to flooding, 25% are due to earthquakes, 20% are due to storms, 12% are due to drought; 2% to wildfire, and under 1% to volcanic eruptions (Amos, 2016). Nevertheless, there is a dramatic reduction in disaster mortality in selected countries and regions during the last decade (UNISDR, 2015d).

China, the United States, India, the Philippines and Indonesia constitute together the top 5 countries that are most frequently hit by natural disasters over the last decade (Guha-Sapir et al., 2016). Asia accounted for the highest number of disaster victims (2005-2014 decade average of 80.6%) followed by Africa which accounted for 2005-2014 decade average of 13.1%.

According to the Annual Disaster Statistical Review 2015, hydrological disasters represented the largest share in natural disaster occurrence in 2015 (46.5%), followed by meteorological disasters (33.8%) (Guha-Sapir et al., 2016). Given the adverse effects of climate change, it is more likely that the frequency and intensity of hydro-metrological extreme events have increased (Dominey-Howes, 2015). It was evident that human induced climate change had resulted in 14 of 28 storms, droughts, and other 2014 extreme weather events investigated by global scientists (Loftis, 2015). More widely, climate change is expected to increase the intensity and frequency of existing hazards (World Bank, 2015). In contrast, according to trends in geophysical events have remained stable (Leaning and Guha-Sapir, 2013).

Over the last decade, the scale and impact of disasters has increased as a result of increased urbanisation, deforestation, and environmental degradation, and to intensifying climate variables such as higher temperatures, extreme precipitation, and more violent wind and water storms (Leaning and Guha-Sapir, 2013). As such, climate change mitigation, adaptation and DRR have been identified as some of the methods to mitigate the risks and adverse impacts of disasters, and to increase society's resilience.

3.2 Global Policy Context

Global policies are important to unify different parts of the world. Three main global policies that address DRR and CAA: the Sendai Framework for Disaster Reduction 2015-30 (SFDRR); the Sustainable Development Goals (SDGs); and, the Paris Climate Agreement have been considered in this report.

3.2.1 Sendai Framework for Disaster Risk Reduction (SFDRR)

The SFDRR was introduced at the Third United Nations World Conference on DRR, held in Sendai, Japan in 2015. This framework provides concise, focused, forward-looking and action-oriented post-2015 framework for DRR. This framework complements and replaces the Hyogo Framework for Action while identifying the gaps and challenges to be further addressed. As an action-oriented framework, this can be implemented by governments and stakeholders in a complementary manner. The framework highlights the importance of disaster governance, stakeholder participation, and disaster preparedness against future disasters (UNISDR, 2015b). It further emphasises the impact of climate change and its effects on disasters. The SFDRR focuses on a strategy that is a multi- hazard approach covering disaster losses between 2015 and 2030. The aim of the framework is to achieve a substantial reduction of disaster risk and losses in lives, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. This will be achieved through four priority areas (UNISDR, 2015b):

Priority 1: Understanding disaster risk.

Priority 2: Strengthening disaster risk governance to manage disaster risk.

Priority 3: Investing in DRR for resilience.

Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Within the aforementioned priority areas, seven global targets have been presented;

- Substantially reduce global disaster mortality by 2030, compared to 2005-2015
- Substantially reduce the number of affected people globally by 2030, compared to 2005-2015
- Reduce direct disaster economic loss by 2030
- Substantially reduce disaster damage to critical infrastructure and disruption of basic services (health and educational facilities) through improving resilience by 2030
- Substantially increase the number of countries with national and local DRR strategies by 2020
- Substantially enhance international cooperation to developing countries to support their national actions by 2030
- Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030

This framework is applicable to both small-scale and large-scale, frequent and infrequent, sudden and slow-onset, man-made or natural disasters. It highlights the importance of national and federal state governments along with local authorities and local communities with allocation of resources, incentives and decision making powers. The framework emphasises the importance of the science-policy interface through dialogues and corporation among scientific communities, other relevant stakeholders and policymakers. They propose to clearly define roles and responsibilities of both private and public sectors through providing incentives, enhancing disaster risk transparency, and establishing proper organisational structures.

3.2.2 **Sustainable Development Goals (SDGs)**

The SDGs, otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These 17 Goals build on the successes of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, among the other priorities. The goals are interconnected – often the key to success on one will involve tackling issues more commonly associated with another. The goals and targets became effective in 1st January 2016 for a 15 years time period (UNDP, 2016).

The 17 goals emphasise the importance of having a global partnership towards successful implementation. This partnership will benefit the poorest and most vulnerable societies by bringing together governments, the private sector, civil society, the United Nations and other relevant actors with available resources. In addition, they promote mainstreaming of gender perspectives in the implementation of the agenda. This is to ensure gender equity and empowerment of women and girls as an important element towards achieving goals and targets.

The role of public finance is also emphasised by the agenda for mobilisation of public resources domestically. This includes the developed countries' official provision of 0.7% of their gross national income for official development assistance (ODA) to developing countries, and 0.15%- 0.2% of ODA to least developed countries. The agreement highlights the importance of national parliaments (for legislative and budgetary allocations) and their roles of accountability for effective implementation.

Climate Action is the 13th development goals. The goal aims to mobilise $100 billion annually by 2020 to address the needs of developing countries and help to mitigate climate-related disasters. It aims to help more vulnerable regions, such as land locked countries and island states, to adapt climate change. This goal suggests to integrate disaster risk measures into national strategies (UNDP, 2016). Similarly, the 13th goal proposes to strengthen resilience and adaptive capacity to climate related hazards and disasters in all countries. More importantly they propose to integrate climate change measures into national policies, strategies and planning. The need to enhance human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning are all highlighted in the goal. They further aim at enhancing capacities among least developed countries, small island developing countries with more focus on women, youth and local and marginalised communities towards effective climate management. It emphasises the support of international financial institutions for developing countries. In addition, they recommit to enhance the voice and participation of developing countries in international economic decision making, norm setting and global economic governance.

Goal 11 deals with sustainable cities and communities. This is to ensure cities and human settlements are safe, resilient and sustainable. Accordingly, this goal aims to overcome the challenges face by cities and support them to continue to thrive and grow, while improving resource use and reducing pollution and poverty. It focuses on areas such as adequate, safe and affordable housing and basic services, sustainable transport systems, inclusive and sustainable urbanization, participatory, integrated and sustainable human settlement planning, inclusive and accessible, green and public spaces, and cultural and natural heritage. It also emphasise the importance of reducing economic losses of disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations. It further aims to reduce the environmental impact of cities and improve social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.

The framework of Global Partnership for Sustainable Development is proposed to be the way of implementing the SDGs with the support of policies and actions outlined in the Addis Ababa Action Agenda which set out a global financing framework for post 2015 development agenda. This is an integral part of 2030 Agenda for Sustainable Development. It deals with domestic public resources, domestic and international private business and finance, an international development corporation, international trade, debt, addressing systematic issues of science, technology, innovation and capacity building, data, monitoring and follow-up.

3.2.3 **Paris Agreement**

At the Paris climate conference in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. This agreement operates within the United Nations Framework Convention on Climate Change (UNFCCC). This was signed by 197 UNFCCC members and ratified by 126 members as of December 2016. The Paris Agreement shall enter into force on the 30th day after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global greenhouse gas emissions (GHG) have deposited their instruments of ratification, acceptance, approval or accession with the Depositary. The first of these thresholds was achieved on 22 September 2016.

According to the Article 2 of the agreement, its objectives are:

1. To maintain global average temperature to below 20C when compared to pre-industrial levels and to limit the temperature rises to 1.50C above pre-industrial level.
2. To increase the ability of adaptation to climate change, to improve climate resilience and reduce GHG emission without any threats to food production.
3. Make available financial sources for low GHG emissions and climate resilient development.

One of the main features of the Paris Agreement is its “bottom up” structure. As it emphasises consensus building among members, it accepts voluntary and nationally determined targets. Hence their climate goals are politically supported rather than legislative requirements. This agreement makes all parties to submit emission reduction plans. Their plans are based on the principle of “Common but Differentiated Responsibility” due to differences between capacities and duties to climate action among nations. Further, there is no specific treatments between developed and developing nations.

According to Article 3 of the agreement, the contribution of each member should be set individually by considering the principle of ambition, represent a progression over time and with the view to achieve the ultimate purpose of the agreement. These are known as “Nationally Determined Contributions”.

The agreement contains collective, long-term adaptation goals. According to Article 7 of the agreement, parties establish the global goal on adaptation towards enhancing adaptive capacity, strengthening resilience and reducing vulnerability. They identify adaptation as a global challenge and developing countries require immediate actions since they are more vulnerable to climate change. Similarly, the adaptation actions should be country driven, gender responsive, participatory and transparent approaches based on available scientific knowledge, traditional knowledge, knowledge of indigenous people and local knowledge when integrating adaptation into other policies and actions (UNFCCC, 2016).

3.2.4 Role of the global policy frameworks in integrating CCA and DRR and facilitating trans boundary crisis management

3.2.4.1 *Integration of CCA and DRR*

The SFDRR is a 15-year non-binding agreement, which advocates States' role of reducing disaster risk while sharing the responsibility with other stakeholders including local government, the private sector and other stakeholders. The framework aims to substantially reduce disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries (UNISDR, 2015). It recognises that many disasters are exacerbated by climate change and call for dedicated action focusing on underlying disaster risk drivers such as climate change and variability. Climate change is considered as one of the drivers of disaster risk and the framework recognises the importance of respecting the mandate of the United Nations Framework Convention on Climate Change. It calls for coherence between development, strengthening and implementation of relevant policies, plans, practices and mechanisms across climate change and variability. It also recognises that effective DRR contributes to sustainable development. While recognising that disasters undermine the efforts to achieve sustainable development, it recalled the outcome document of the United Nations Conference on Sustainable Development, held in 2012 which called for a renewed sense of urgency in the context of sustainable development to be integrated at all levels. The Framework calls for coherence between development, strengthening and implementation of relevant policies, plans, practices and mechanisms across sustainable development and growth.

The new SDGs, which was adopted on 25th September 2015, consists of a set of goals to end poverty, protect the planet and ensure prosperity for all. For the goals to be reached in the 15 years, it also calls for everyone to do their part including government, the private sector, civil society and people (UN, 2015). Out of the 17 goals, some of the goals are specifically linked with disaster risk reduction and climate change. For an example, goal no. 11, sustainable cities and communities is specifically linked with disaster risk reduction. It aims to make cities inclusive, safe, resilient and sustainable. This goal has specific reference to SFDRR and highlights the importance of holistic disaster risk management in line with the Sendai Framework for Disaster Risk Reduction. As such, it is clear that SDGs have tried to create some coherence between sustainable development agenda and Sendai Framework.

Similarly, there is a specific goal for climate action, which aim to combat climate change and its impacts. It recognises the Paris Agreement and that all countries agreed to work to limit global temperature rise to well below 2 degrees Celsius, above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius (UNFCC, 2015). The SDGs recognise the importance of implementing the Paris agreement for the achievement of the SDGs and provide a roadmap for climate actions that will reduce emissions and build climate resilience (UN, 2015). Similarly, Paris agreement has number of references to sustainable development. It has tried to look at climate change in the context of sustainable development and tries to promote sustainable development and environmental integrity. However, within the agreement there is no specific reference to SFDRR and SDGs.

3.2.4.2 *Trans boundary crisis management*

Across the global policies, a high prominence has been given to trans boundary cooperation and crisis management.

The SFDRR recognises the pivotal role of international, regional, subregional and transboundary cooperation in supporting the efforts of States, their national and local authorities, as well as communities and businesses, to reduce disaster risk. It highlights that each State has the primary responsibility to prevent and reduce disaster risk, including through international, regional, subregional, trans boundary and bilateral cooperation. It guides actions at national and local levels, as well as regional and international levels, to foster more efficient planning, create common information systems and exchange good practices and programmes for cooperation and capacity development, in particular to address common and trans boundary disaster risks. As such, the framework recognises the trans boundary nature of disaster risk and guide action at the regional level through agreed regional and subregional strategies and mechanisms for cooperation. Moreover, the importance of trans boundary cooperation is also recognised in relation to ecosystem-based approaches with regard to shared resources, to build resilience and reduce disaster risk, including epidemic and displacement risk, and the framework highlights the importance of promoting trans boundary cooperation to enable policy and planning for the implementation.

Similarly, the Paris Agreement advocates global and regional cooperation and views climate change and adaptation in a global dimension. It brings all nations into a common cause to combat climate change and adapt to its effects, with enhanced support to assist developing countries (UNFCC, 2015). The agreement recognises adaptation as a global challenge with local, subnational, national, regional and international dimensions, and a special emphasis has been given in enhancing the capacities of developing countries to implement, including through regional, bilateral and multilateral approaches. Likewise, the SDGs has a dedicated goal on revitalising global partnerships for sustainable development which recognise the transboundary nature of the problem and the importance of trans boundary cooperation. Accordingly, this goal highlights the essential role of the partnerships at the global, regional, national and local level. Hence, it will enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the SDGs in all countries, in particular developing countries (UN, 2015).

3.2.4.3 *Coherence across policies*

These global policy frameworks have created a significant opportunity to build coherence across overlapping policy areas (Murray et al., 2016). It is expected that these global agreements provide a foundation for a shared aim of making development, sustainable, resilient and safe (Wahlström, 2015). However, a large number of agreements have created challenges, especially in terms of implementation and monitoring. As such, how the policy commitments are put into practice is less straightforward (Carnwath, 2016). According to (Kelman, 2015), although they are trying to connect and follow each other closely, they are not coming together fully. For example, the SFDRR lacks an appropriate framing of climate change. Although climate change has been identified as one of the risk drivers, it hasn't been given an adequate prominence. The primary focus was given on tacking root courses of disaster risks, i.e. vulnerability which undermines climate change.

In order to achieve the goals of the global agreements it is important that we integrate them. According to (Velasquez, 2017), working in separation prevents a holistic perspective and can lead to resource problems. Murray et al. (2016) emphasise that none of the frameworks engage with a full range of risk drivers. They highlight the importance of a systematic view of risks in order to bring frameworks together. Therefore, there is a potential to design finance mechanisms, policies and programmes that can deliver more than one set of frameworks (Peters et al., 2016). This will help to achieve the objectives of the frameworks effectively, efficiently and sustainably.

Murray et al. (2016) highlight the importance of identifying the synergies between policies, programmes and institutions in order to align the actions. They propose 7 recommendations in building coherence between the agreements and global agendas. Recommendations include, raising awareness on how the different frameworks align, facilitating key partnerships to work across agreements, instituting clear governance arrangements for collective action and accountability, developing consistent definitions, promoting science and technology involvement, joined up monitoring processes and ensuring national ownership and leadership on all the frameworks. Moreover, a successful DRR depends on better use of science and technology and how science and technology can provide evidence for policy. According to (Carabine, 2015), science is included as a core element of the SFDRR; however, implementation in practice is still unclear.

3.3 European Union

Europe has seen proliferating attention being paid to issues of disasters and climate change. It is needless to say that the number of disasters (of different forms and with different magnitude) has increased. This calls for immediate attention to be paid to issues of DRR and CCA. The Danube River is the second-longest river on the European continent and the longest within the EU. On a global scale, however, Danube remain a small river. Nonetheless, Danube is the river in the world that flows through most countries, crossing ten countries from its origin in Germany to the estuary where it meets the Black Sea off the coast of Ukraine. The Danube thereby serves as a good example of the deep geographical interdependence European states have when managing disaster risk as well as effectively adapting to climate change. Other examples of the border-crossing nature of Europe leading to Union-wide disturbances can be seen through the release of ash from Icelandic volcanoes, water from other river basins, not least the Rhine and the Elbe, or earthquakes in Southern Europe.

In addition to the spatial, geographical co-dependencies described above, Europe has increasingly centralized and hybridized its infrastructure. In 2006, a routine disconnection of a power line in North-Western Germany went catastrophically wrong, cascading into blackouts from Poland to Portugal and from Benelux to Greece (UCTE, 2006). Thus, today European states are interconnected via a plethora of physical infrastructures providing vital services like the internet, electricity and water across the continent. In turn, Europe is socially and institutionally interconnected. So when a serious economic burden, for instance brought on by disaster losses, befalls one member state, it affects the entire Union economically and may have longer-term impacts on the political stability of the European Union.

In sum, Europe's geographical interdependence; shared physical infrastructure; and close social and institutional integration necessitates close regional cooperation in the management of disaster risk in general, and climate change in particular. Today, DRR and climate change adaption is not only a local problem, but also engenders a European one.

3.3.1 Hazard Profile

Europe experiences a variety of natural hazards, such as floods, earthquakes, droughts, landslides and wildfires. Most of these are being enhanced by climate change, and a majority of disasters in Europe since 1980 has taken place the past 13 years (Munich, 2015). The following section presents a brief risk profile of Europe from the last decade, listing the main natural disaster occurrences (flooding, landslides, heatwaves, drought), its effect on the continent and projections for disasters in the future. Below is a brief description of some of the natural hazards Europe is prone to.

3.3.1.1 *Rainfall and Flooding*

Heavier rainfalls and more frequent storms have become apparent hazards in Europe the last decade. This has led to an increase in severe pluvial, fluvial and river flooding across the continent. England and Wales had their wettest summer on record in 2007, with Greece and Bulgaria experiencing severe flooding in the winter of 2015 leading the European Commission to grant 16 million euros in aid relief. Flooding is thus one of the largest disaster risks to Europe, and a study by the Joint Research Centre in 2015 project that by 2050 half a million Europeans can be affected by flooding (European Commission, 2015).

3.3.1.2 *Landslides*

Heavy and prolonged rains is furthermore a main cause of landslides, which posess a large risk in Europe today. A spatio-temporal analysis of fatal landslides for 27 European countries from 1995-2014 by the European Geophysical Union showed an increase of severe landslides from 2008 and onwards. A total of 1370 people have lost their lives the last two decades due to landslides, with economic losses in Italy alone reaching €3.9 billion per year. Landslides are however geography dependent, with mountainous areas in Europe being at the highest risk (EGU, 2016).

3.3.1.3 *Extreme Temperatures*

As climate change leads to higher temperatures, Europe has seen a large increase in heatwaves across the continent. Since 2000, heatwaves have broken heat records in 65% of Europe going back to the 1600's. Most notably was the 2010 heatwave in western Russia and eastern Europe which resulted in 55,000 excess deaths, as well as causing wildfires and severe drought on the continent (European Environment Agency & European Topic Centre on Climate Change Impacts Vulnerability and Adaptation, 2015). The average overall temperatures during summer are increasing, with the most recent years being of particular significance: Austria saw in 2015 its most extreme summer, with 2.5 degrees celsius above average throughout the months of June - August. Germany, the Netherlands,France and Spain all broke heat records that same summer with Madrid reaching temperatures of 40 degrees celsius, the highest since 1943 (European Environment Agency & European Topic Centre on Climate Change Impacts Vulnerability and Adaptation, 2015).

3.3.1.4 *Droughts*

Europe is considered rich with water resources. However, the continent is simultaneously not exempt from water scarcity and thus faces substantial drought risks. In a study commissioned in 2007, it was found that nearly 33 river basins were affected by this issue (EU, 2007). In 2011 and 2012, it was found that droughts affected Southern, Western and even some Northern parts of Europe. Even though Europe has witnessed increased rainfall, adequate water resources are becoming scarce in certain regions and rising temperatures have led to more severe droughts in Europe. 2010-2012 saw prolonged droughts in Russia and Central Europe and the summer of 2015 with record-breaking temperatures saw severe droughts in France, Benelux, Germany, Hungary, the Czech Republic, northern Italy, and northern Spain. Restrictions on civil and industrial uses of water had to be put in place, and the regions affected saw losses in agriculture production due to low soil moisture, increases in wildfires, losses in biomass accumulation in forests and much higher energy and capital usage on cooling and irrigation systems (European Drought Observatory, 2015).

3.3.1.5 *Earthquakes*

Europe is moreover not free from seismic activity. Some of the major earthquakes from recent times include the L'Aquila earthquake in Italy in 2009. Italy was additionally affected by several major quakes in early 2017 as well (The Telegraph 2017). More information on Europe seismic activity as a disaster is available through the SHARE project, which is funded by the EU (SHARE, 2017).

3.3.1.6 *Volcanoes*

Volcanoes also serve as a disaster threat in Europe, as eruptions or other volcanic activity could lead to earthquakes or polluting ash-clouds that could have serious effects on the whole continent. The 2010 eruptions of Eyjafjallajökull in Iceland is a classic case of how it affected daily routines and life in Europe in general. There are 32 volcanoes in Iceland alone and a total of 47 in continental Europe (Loughlin et al., 2017). Further, "15 million people in Europe live within just 30 km of an active volcano; of these, more than 2.2 million live within 20 km of the Campi Flegrei caldera in Italy and more than 675 000 live within 10 km of Vesuvius" (ibid).

3.3.1.7 *Wildfires*

Due to the rise in temperatures across the continent, as well as prolonged droughts, wildfires are projected to become more frequent and severe in Europe. Västmanland County in Sweden saw in the summer of 2014 a total of 15 000 hectares of forest severely damaged by fires. Wildfires are furthermore beginning to affect new areas, such as southern Greece in 2007, where we witnessed wildfires sprawl in areas that had never previously been prone to the phenomenon (European Environmentl Agency, 2016). The summer of 2016 simultaneously saw severe fires across southern Europe, hitting France and Portugal the hardest with thousands having to evacuate and up to 10 people lost their lives (Al Jazeera, 2016). Recent studies have estimated a potential increase of 200% in burnt areas in the 21st century under a high emissions scenario with no adaptation, and that it would more than double in Southern Europe for a reference climate scenario and increase by up to 50% for a 2 degree increase in global temperatures (ibid). Wildfires therefore present a severe threat for the populations of Europe, and as profound shifts in the climate proliferate, the risk poses an ever-growing spectre.

3.3.2 **The Central EU Actors in DRR and CCA**

This section describes some key central EU actors in DRR and CCA.

3.3.2.1 *DG ECHO*

The European Civil Protection and Humanitarian Aid Operations (ECHO) is the EU's department for aid and emergency relief assistance. Its mandate is to provide protection and help to victims of disasters and conflict, both natural and manmade within and outside the EU. ECHO's mandate has also extended to areas such as disaster prevention and development projects through funding of operations by over 200 partner organizations. ECHO is an important actor within the field DRR, and spends approximately 13% of its humanitarian budget on initiatives concerning DRR, with the Disaster Preparedness ECHO Programme (DIPECHO) being the main agent for DRR activities. The program focuses specifically on resilience-building among communities, on a local, regional and national level, to reduce risks, better preparedness and increase their capacities in dealing with disasters (European Commission, 2017d). The DG ECHO's DRR actions are guided by the following principles:

a. DRR is a key part of the Humanitarian Imperative
b. With a focus on natural hazards, DG ECHO adopts a multi-hazard approach
c. DG ECHO promotes a people centred approach to DRR
d. DG ECHO requires programmes to be risk informed
e. DG ECHO seeks complementarity and partnership in its DRR action

Quoted from- (European Commission, 2013b)

3.3.2.2 *DG Climate Action (DG CLIMA)*

The Directorate-General for climate action, DG Clima, is the main body of the European Commission responsible for climate change and climate policy in the union. The directorate drafts, implements and monitor policies and strategies for climate action on a national and international level; an example being the EU's CCA strategy. DG Clima is the lead actor in international negotiations on climate for the European Commission, and the main driver and implementer of the EU Emission Trading System, the first and largest carbon trading market in the world (EU ETS). It furthermore provides financial support to innovation and adaptation measures, and manages, with DG Environment, the EU's main funding instrument for climate action: the LIFE programme. The LIFE Programme's budget for funding to projects on climate change and environmental protection is over 373 million euros, with the Commission being specifically interested in "close-to-market" projects; project that are readily adaptable to the market and business sector (European Commission, 2017g). The directorate also works to mainstream climate action and adaptation into EU legislation and policy to ensure the goal of 20% of the EU's budget being used on climate-related expenditures (European Commission, 2017a).

3.3.2.3 *DG Environment (DG ENV)*

The Directorate-General Environment is the main body in the European Commission working with environment policy and implementation in the EU. The DG follows multi-annual working programmes, with annual plans containing specifics on action to be taken the coming year (European Commission, 2017a). The DG is currently on its 7th Environment Action working programme, where 1 out of 3 objectives is that "The Union's citizens are safeguarded from environment-related pressures and risks to health and well-being" (General Union Action Programme 2020). The Directorate work to reduce environmental pressures from areas such as agriculture, transport and households which will have great effects on lowering risks to disasters such floods and droughts (European Commission, 2017a).

3.3.2.4 *DG International Coperation and Development (DG DEVCO)*

The Directorate-General for international cooperation and development is the main body responsible for the EU's policies on international aid, development and cooperation. It formulates and implements the EU's development policies, and manages the external aid instruments of the EU (DG DEVCO). Of the European Commission's top 10 priorities, DG DEVCO's work is specifically focused on four, with the priority of "A Resilient Energy Union with a Forward Looking Climate Change Policy" being one of these. The Directorate aims to assist partner countries in climate-resilient and sustainable development. An example of this is the DGs high involvement in the Global Climate Change Alliance; and alliance working with the implementation of national CCA and mitigation policies in countries at risk (European Commission, 2017j).

3.3.2.5 *European Environment Agency (EEA)*

The EEA is an independent agency of the EU that provides the Union, its member states and other relevant actors with information on the environment. Its mandate is to assist the community with the needed information on environmental issues to make informed decisions on environmental policies, good implementation of projects and to mainstream the environment in economic policies (European Environment Agency, 2017). The EEA currently has 33 member countries and six cooperation countries. It collects data and makes assessments on a wide range of topics; CCA being one of the main ones. The agency is also responsible for the coordination of the European Environment and Information Network (Eiont); a network consisting of around 1000 experts from 39 countries in up to 400 national bodies working with the environment. This platform is essential for the collection of data needed by the EEA and its clients.

3.3.2.6 *International Centre for Climate Governance (ICCG)*

The ICCG is a European research institution focused on climate change mitigation and adaptation. The research is to be of an interdisciplinary nature and is aimed at developing policy analyses and effective governance models for climate change management. The centre has 3 observatories; Climate Policy Observer, Best Climate Practices and Think Tank Map - all geared towards evaluating, ranking and disseminating information on climate governance, adaptation and mitigation. In 2017, DRR is listed as a 1 of 5 "Hot Topics" to be paid particular attention to by the ICCG and an increased focus through research, seminars and events will be placed on DDR "to create a platform for the dissemination of information that is both comprehensive and approachable to policymakers and the public".

Given the comprehensive nature of the challenge of DRR and CCA, obviously other institutional actors play an role in the complex governance system.

3.3.3 Snapshot of Legal and Policy Frameworks

The aim of this section is provide an overview of legal and policy frameworks in the context of DRR and CCA. It has been very difficult to segregate the two. One policy on DRR may have impacts for CCA and vice-versa. Further, although transboundary issues are identified as a separate challenge, it is combined with this section as the frameworks and policies have far reaching effects on DRR and CCA for not only member states but also across their boundaries. To avoid confusion- section 3 provided an overview of actors . This section has been divided as follows: frameworks in relation to DRR; relevant transboundary issues; frameworks having implications for CCA. It must be noted that these frameworks are not sacrosanct in the headings provided below. They cross over different thematic areas of DRR and CCA along with national boundaries.

3.3.4 Central EU Legal/policy frameworks in relation to DRR

3.3.4.1 *New Civil Protection Mechanism Legislation to strengthen European policy on disaster management (1313/2013/EU)*

The revised EU's Civil Protection Mechanism (CPM) integrates all aspects needed for a comprehensive disaster management policy: disaster prevention, disaster preparedness and improved response arrangements. To promote a culture of risk prevention, the new legislation will require the Member States to share a summary of their risk assessments and to refine their risk management planning. To better prepare for disasters, there will be more training available for civil protection personnel operating outside their home countries, more exercising of civil protection response capacities (such as search-and-rescue teams and field hospitals), more exchanges of civil protection and prevention experts and closer cooperation with neighboring countries. For a stronger and more efficient response, the legislation envisages the creation of a voluntary pool of Member States' assets (teams, equipment) available for immediate deployment as part of a joint European intervention. Member States will remain responsible for their assets while the Commission's role will be to facilitate and coordinate deployment on the ground. For each emergency, the Emergency Response Coordination Centre

(ERCC) will put together an immediate response plan, matching the capacities available from the voluntary pool with the needs on the ground. The ERCC will then call upon the Member States to deploy the needed capacities. The final decision to deploy will remain with Member States (European Commission, 2013e).

A Community Civil Protection Mechanism was established by Council Decision 2001/792/EC Euratom, with the financing of the mechanism being ensured by Council Decision 2007/162/EC, Euratom, which established a Protection Financial Instrument. This expired in 2013, thus creating the space for the Union Civil Protection Mechanism. The funding for the legislation between 2014 and 2020 is €368,428,000 with two thirds of this deriving from the “Security and Citizenship” of the multiannual financial framework and €144, 652, 000 from the “Global Europe” heading (European Commission, 2013d). According to the legislation outline, the annual appropriations shall be “authorised by the European Parliament and the Council within the limits of the multiannual financial framework” (ibid).

Another part of the Mechanism is the **CECIS (Common Emergency Communication and Information System)**, a web-based alert and notification application enabling real time exchange of information as well as emergency communications and monitoring tools (European Commission, 2014a).

CECIS is exclusive to the EU system and even within the system, only a few selected Contact Points in member states, the ERCC and other relevant personnel have access. It is a physical, private network. CECIS is not intended for field use and is only accessible from selected sites. The reason for this is that the information stored in the system is highly sensitive (ibid). The pre-committed modules are listed, as well as a long range of experts, their specific expertise, language skills, location etc. Further, locations of merchandise, goods central infrastructure such as for example airports and ports are listed with contact information.

The existing focus of the ERCC and DG ECHO is on Response and Preparedness with an emphasis on a transition from ad hoc coordination to a pre-planned, pre-arranged and predictable system. This transition includes four focus areas that are of highest priority: better planning (reference scenarios, mapping of assets, contingency plans); emergency response capacity (availability and sharing of key assets); emergency Response Center Training network and the lessons learnt programme.The number of operations is divided in requests for assistance, pre-alert and monitoring. Generally there are more requests for assistance from countries outside the EU than inside the EU; in 2016, 18 requests were made from outside the EU whereas 8 requests were made from inside the EU (European Commission, 2017i).

3.3.4.2 ***SFDRR and the EU***

The SFDRR is a global agreement signed by the UN member states in March 2015, being the first major agreement following the post-215 development agenda set by the United Nations General Assembly. The agreement consists of seven global targets and four priorities for action on disaster reduction. It is a non-binding agreement running from 2015-2030 and is implemented and reviewed by the United Nations Office for DRR (UNISDR, 2015a).

In June 2016 the European Commission launched its Action Plan to follow up on the recommended policies set by The SFDRR in 2015.The Action Plan covers a five-year period, and offers specific tasks on risk knowledge, risk investments, disaster preparedness and resilience.The European Commission carries out regular reviews and assessments of the Action Plan to track progress within EU Member States, civil society and the private sector (Action Plan 2015-2030). The action plan furthermore contributes to the implementation of other important global agreements such as the Paris Climate Change Agreement (COP21).

The plan combines the key priorities in the SFDRR with existing policies, initiatives and institutions in the European Union. EU policies on DRR are to be synergized with the SFDRR on its 4 key priority areas – and due to the EU’s high involvement in the development of the framework, many policies and initiatives are already aligned, which are outlined in detail in the Action Plan (ibid). However, as the plan points out, a more systematic risk-informed approach for all of EU policies are needed to meet objectives set by the SFDRR. The plan states what actions need to be taken to achieve this in accordance with the 4 key priorities:

1. **Building risk knowledge in all EU policies (Sendai #1 - Understanding Disaster Risk):**
- Actions include enhanced sharing and collection of loss and damage data between member countries, engaging with the research community and encouraging stronger links between science and policy in decision-making (ibid 3-6).
2. **An all-of-society approach in disaster risk management (Sendai #2 - strengthening disaster risk governance to manage disaster risk):**
- Actions include working with stakeholders in a wide array of sectors and disciplines to ensure risk

awareness, encourage innovation, reinforce the link between DRR and CCA, as well as supporting countries in their development of DRR strategies (ibid:3-4).

3. **Promoting EU risk-informed investments:**

- This includes tracking DRR investments in humanitarian and development aid, and promoting and implementing sustainable and climate-friendly investments in DRR (ibid 4).

4. **Supporting the development of a holistic disaster risk management approach**

- This includes increasing capacities and cooperation on disaster response and preparedness related to high health dangers in the EU, as well as developing guidelines on the integration of cultural heritage in members states' national strategies on DRR (ibid: 4 and 14).

3.3.4.3 *EU Green Paper on Insurance of Natural and Manmade Disasters (2013)*

The EU Green Paper on Insurance and Disaster present and discuss different issues regarding the adequacy, availability and need of disaster insurance as a part of disaster risk management. Its aim is to assess whether action at the EU level is needed to improve the market for disaster insurance, and to promote insurance as a tool of disaster management. The Green Paper argues that insurance will be increasingly relevant in a changing European climate – it does not prevent disaster or the subsequent damages, but it greatly reduces the impacts and better the recovery after the event. Increasing risks frequency of disasters are a result of our changing climate, insurance might become increasingly difficult to obtain in high-risk areas. This lack of insurance leads to higher vulnerability which again leaves governments with large financial expenditures in the case of a disaster. Well-functioning disaster risk insurance systems, private or public, therefore plays a central role in disaster management, and can furthermore work as an instrument to reduce risky behavior and mainstream disaster proofing in economic decisions. It is on the background of these arguments, that the Green Paper pose the possibility for the European Union to facilitate and support increased coverage of appropriate disaster risk insurance (European Commission, 2013d).

Market-based by the utilisation of compulsory disaster insurance and disaster insurance pools. In the legal framework, the Commission outlined how "insurers can provide market-based incentives for risk prevention… (to) motivate insured persons to take individual measures to reduce the vulnerability of their property" (ibid). In turn allowing the insurers the "freedom to set insurance premiums" (ibid); the initiative also allows public authorities the space to impose regulation on the insurance rates. Overall, as a Green Paper it's aim is to pose questions 'concerning the adequacy and availability of appropriate disaster insurance" (ibid) leading to no direct legislation, allocated funding or central management.

3.3.4.4 *EU Floods Directive (2007/60/EC)*

One of the most frequent disaster types in the EU is flooding. In turn, the Directive 2007/60/EC on the assessment and management of flood risks entered into force on 26 November 2007 to manage this specific type of hazard (reference) emphasizing a participatory environmental governance approach (Newig et al., 2014). The directive was 'coordinated with the implementation of the WFD from the second river basin management plan onwards' (Quevauviller, 2011). The aim of the directive is to have Member States assess if their water courses and coastlines are at risk from flooding, to map the extent of flooding as well as humans and assets at risk in these areas and to take adequate and coordinated measures to reduce the flood risk.

Its aim is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive applies to inland waters as well as all coastal waters across the whole territory of the EU (European Commission, 2016b). The updated plan now consists of a second Preliminary Flood Risk Assessment with a specific requirement on climate change, due in 2018, this is also when the Commission's first implementation report is due (European Commission, 2016b). It has been noted that the implementation of the Floods Directive has been affected by the 'difference structures, methodologies and data conditions used for preliminary flood risk assessments, hazard and risk maps and management plans' (Nones, 2015) across Member States and therefore the post-2015 implementation cycle must 'minimise these technical differences' (ibid).

3.3.4.5 *European Programme for Critical Infrastructure Protection (EPCIP)*

The EPCIP came is based on a review of the 2006 programme on critical infrastructure and the Council Directive 2008/114/EC. The Council Directive of 2008/114/EC relates to assessment and protection of critical infrastructure. The programme focuses on reducing the vulnerabilities of critical infrastructure and resilience-building in the energy and transport sector. Eurocodes, a set of European Standards on the structural design of buildings, address climate and disaster resilience in other infrastructure sectors. Green Infrastructure-related standards has furthermore been included in the Union Work Programme for European Standardization (UWP) for the coming years; a program encompassing the European Commission's intentions to use standardization on new or existing legislation and policies (European Commission, 2017h).

DRR is also integrated in cross-border health by risk assessments on cross-border threats of environmental origin done by the Health Security Committee upon request by the European Commission or the Member States. The Directive also included the setting up of a Critical Infrastructure Warning Information Network (CIWIN) by the Commission, as an internet-based protected information and communication system for discussing the exchange of best practices and 'providing an optional platform for the exchange of rapid alerts linked to the Commission's ARGUS system' (European Commission, 2006). The ECIP was co-financed by the Community Programme 'Prevention, Preparedness and Consequence Management of Terrorism and other Security Related Risks' for the period 2007-13 (ibid).

In 2013, the Directive was evaluated in terms of progress and, according to the Commission's website, it was suggested that the programme enter a new, more practical phase (European Commission, 2017h). This phase involves launching a pilot project analysing four critical European infrastructures that could be vulnerable to threats. These are: 'the EU's electricity transmission grid; the EU's gas transmission network; EUROCONTROL and GALILEO – the European programme for global satellite navigation' (ibid). In the post-2014 approach is led by DG HOME with the scientific support of the Joint Research Centre, in conjunction with the four selected critical infrastructures and associated Directorates-General (i.e. DG MOVE, DG ENTR, Dstaff wG RTD, DG ENER and DG ECHO) (European Commission, 2013a).

3.3.4.6 *EU Directive on Off Offshore Oil and Gas Operations (2004/35/EC)*

The Directive has established a set of rules to ensure safe exploitation of oil and gas, and to furthermore help prevent accidents, limit their consequences, and to respond quickly and efficiently if one is to occur. The aim is to enhance the protection of the environment and reduce the risk of disasters such as oil spills and addresses as a central purpose, 'the cumulative impacts from all activities on the marine environment, and is the environmental pillar of the Integrated Maritime Policy' (European Commission, 2004). For instance, before exploration or production begins, companies must prepare a Major Hazard Report for their offshore installation. This report must contain a risk assessment and an emergency response plan. National authorities within Member States must also verify safety provisions, environmental protection measures, and the emergency preparedness of rigs and platforms. If companies do not respect the minimum standards, EU countries can impose sanctions, including halting production. Companies will also be fully liable for environmental damages caused to protected marine species and natural habitats (ibid).

The responsibility of the Directive is on Member States to bring into force the laws, regulations and administrative provisions necessary to comply (ibid) and inform the Commission. The Directive is also up for report and review in July 2019 to assess the experience of implementation, to be submitted to the Parliament and Council (ibid).

It does appear that these DRR policy frameworks within the EU act 'as a legitimate teacher of norms on DRR', and simultaneously play a role in supporting regional civil protection (Hollis, 2015). Konstadinides highlights the potential of the Article 222 'Treaty on the Functioning of the European Union's (TFEU) solidarity clause, which 'calls upon member states Member States working together with the EU institutions to assist one another in the event of a terrorist attack, made-made disaster or natural disaster' (EU Clause). He states that the TFEU could be a 'potentially inimitable tool for connecting policies and programmes across sectoral and institutional boundaries' (Konstadinides, 2013). Hollis argues that the 2014 version of the civil protection mechanism for instance has disaster mentioned 41 times, using the term 'culture of prevention' (Hollis, 2015). Hollis believes this substantial increase in discourse by the EU on prevention 'is the start of a more inclusive position on disaster management…. on prevention and preparedness' (ibid). However only 20% of the budget for DRR and management is currently allocated to prevention (Council of the EU, 2014, Annex 1 in Hollis, 2015) with the rest on post-disaster reconstruction.

Overall, by understanding the state of the art for DRR in Europe, we can see that the way in which legal and policy frameworks are approached can have radically different effects on different countries when disaster strikes. In turn, highlighting the 'slow, complex and often contradictory developments' (Rothstein et al., 2013) within both EU legal and policy frameworks.

3.3.5 Trans-boundary Issues at the EU Level

There are many frameworks and directives dealing with transboundary issues at the EU level. They include both disasters induced by natural hazards and human-made disasters. For the scope of this report, we focus on the natural hazard induced disasters. In this context, we discuss briefly the key issues of the water framework directive (WFD); the European programme for critical infrastructure protection among others.

3.3.5.1 *EU Water Framework Directive (2000/60/EC)*

On 23 October 2000, the "Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy" or, in short, the EU Water Framework Directive (WFD) was adopted (European Commission, 2010). It is 'widely accepted as the most substantial and ambitious piece of European environmental legislation to date' (Voulvoulis et al., 2017). The Directive introduces a new legislative approach to managing and protecting water, based not on national or political boundaries but on natural geographical and hydrological formations: river basins. It also requires coordination of different EU policies, and sets out a precise timetable for action, 2015 was the target date for getting all European waters into good condition. The aim is to reduce risk from pollution in lieu of growing demand, with public participation and river basin management plans as key tools for implementation (ibid). The framework is complemented by other EU legislation regulating specific aspects of water use such as the Groundwater Directive (2006), the Environmental Quality Standards Directive (2008), two Commission Decisions (2005 and 2008) on ecological status, establishing a register of almost 1,500 sites included in an intercalibration exercise to allow for comparison of different countries' standards, and published their results (ibid).

The aim is to bring about a 'fundamental change to water management' (Wilby et al., 2006) by introducing a single system of objectives through the integrated River Basin Management Plans (RBMPs) within specified timeframes. The objectives are to: '(a) prevent further deterioration, protect and enhance the status of aquatic ecosystems and the water needs of terrestrial and wetland ecosystems; (b) promote sustainable water use based on the long-term protection of available water resources; (c) enhance protection and improvement of the aquatic environment; (d) ensure the progressive reduction of pollution of groundwater; and (e) contribute to mitigating the effects of floods and droughts' (Wilby et al., 2006). This framework in turn contributes to the wider DRR and CCA policies in terms of reducing flooding risks, pollution and shifts in ecosystems caused by climate change.

In terms of funding, the Directive stated that Member states are to 'take account of the principle of recovery of the costs of water services and ensuring an adequate contribution of the different water uses to the recovery of costs of water services' (European Commission, 2000). Moreover, the implementation of the WFD raises several issues for the Commission, Member States and relevant stakeholders, with international basins crossing administrative and territorial borders (European Commission, 2017g). In turn, a Common Implementation Strategy (CIS) was agreed on providing guidance documents on technical aspects, key events and additional resource documents (European Commission, 2003). According to Voulvoulis et al. in 2015, fifteen years after its implementation, only '47% of EU surface waters (are) not reaching the good ecological status… a central objective of EU water legislation' (2017: 359).

3.3.5.2 *Water as a Transboundary Issue*

The United Nations Economic Commission for Europe (UNECE) recognizes the significance of working wih transboundary waters in Europe. According to the second assessment report on transboundary waters, it was found that "a factor that has a strong impact on the social and economic situations, on water and the environment, and, above all, on transboundary water cooperation, is the significant number of past — and in some cases still frozen — political conflicts, including in the Balkans, the Republic of Moldova and the Caucasus, and to a lesser degree in Central Asia" (The United Nations Economic Commission for Europe, 2011). According to this report, the EU has suffered more than 175 floods from 2001-2011. The study notes that impacts of climate change will vary drastically across the region and across different water basins. In this context, the EU needs to focus on more holistic approaches that need to be tailored into specific contexts in the region.

The Rhine is a perfect example of a river cutting across many countries serving the case for the need for transboundary dialogue. "The River Rhine provides drinking water for 30 million of the 58 million people who live in the basin, either by direct abstraction (e.g. from Lake Constance), via riverbank filtration, or filtered through the dunes between Amsterdam and the Dutch coast" (The United Nations Economic Commission for Europe, 2011). In this region (Western and Central Europe) it was identified that although there is a good legislative framework in place, long-term political commitment and will is required. Further, good monitoring mechanisms needs to be taken into account with the ever increasing changing nature of hazards in the region.

In South Eastern Europe, there are 13 major rivers cutting across boundaries. There are differences between EU and non-EU countries. While there may be considerable new-laws in the making, implementation is considered a challenge (The United Nations Economic Commission for Europe, 2011). Boin et al. (2014) identify that managing transboundary crises is extremely crucial due to two reasons: the rise of new threats and increasing vulnerability of modern societies to these threats. Some of the examples they provide that can have immense impacts across Europe include:: mad cow disease; the Chernobyl explosion; terror attacks and climate related disasters. They argue that transboundary crises are extremely difficult to manage as ownership of the problem is unclear, further calling for an "interdisciplinary"response to the transboundary case.

The European Flood Awareness System (EFAS) was established as an initiative after the Danube floods of 2002 which caused a major disaster. In response to this, the EU commissioned the Joint Research Centre (JRC) to increase warnings and preparedness. Starting in 2002, the EFAS has had a decade long history of being both a scientific and practical tool. More detailed information is available on the EFAs website[1].

Boin and Rhinard (2008) suggest that addressing three challenges may be particularly relevant when addressing transboundary crises management. They are:

a. *Addressing Coordination*: there should be more coordination between different EU leaders and structures.
b. *Effectiveness of the EU structures*: there is a need for critical thinking around the existing structures. In this context, they call for more research on the effects of transboundary crises and thereby the need to address them immediately.
c. *The issue of democratic legitimacy*: the issue of legitimacy resurfaces when the Union acts as crisis manager. (p.20).

These challenges will be nuanced during the discussion in section 6.

3.3.6 Legal/policy frameworks in relation to CCA

The following section aims to present some of the major and important frameworks within the CCA context. These may obviously have very close connections to disasters and DRR (particularly climatological related).

3.3.6.1 *The European Union's CCA Strategy*

The 2009 White Paper 'Adapting to climate change: Towards a European framework for action', sets out several measures on adaptation (European Commission, 2009). Up to date, 15 EU Member States have adopted an adaptation strategy, with others under preparation. Some of the adopted strategies have been followed up by action plans and there has been some progress in integrating adaptation measures into sectoral policies. However, as adaptation is in most cases still at an early stage, with relatively few concrete measures on the ground, monitoring and evaluation is proving to be difficult, particularly as indicators and monitoring methodologies have hardly been developed (ibid).

The overall aim of the EU strategy on adaptation to climate change is to contribute to a more climate-resilient Europe. This means enhancing the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels, developing a coherent approach and improving coordination. This includes strategies for information sharing, and ensuring that adaptation considerations are addressed in all

[1] https://www.efas.eu/about-efas.html

relevant EU policies. A key deliverable was the web-based European Climate Adaptation Platform (Climate-ADAPT) launched in March 2012. It incorporates the latest data on adaptation action in the EU, together with several useful policy support tools (European Environmentl Agency, 2016).

The strategies' three main objectives are:

Promoting Action by Member States: all Member States are encouraged to take up and implement comprehensive adaptation strategies in accordance with guidelines set by the EU Commission. The Commission will provide funding and guidance for strengthening the adaptation capacities of the Member States in several climate-related vulnerable areas, as well as supporting adaptation in cities through the Covenant of Mayors for Climate and Energy; an initiative between local and regional authorities in implementing EU climate and energy objectives (Covenant of Mayors' for Climate and Energy, 2015).

Better informed decision-making: There is a need to increase information and address gaps in knowledge about adaptation to improve decision-making and further develop the European climate adaptation platform Climate-ADAPT as a 'one-stop shop' and the main agent for adaptation information in Europe. These knowledge gaps include damage and adaptation costs and benefits; regional and local-level analyses and risk assessments; frameworks, models and tools to support decision-making and to assess how effective the various adaptation measures are; means of monitoring and evaluating past adaptation efforts (European Environment Agency, 2017).

'Climate-proofing' action: promoting adaptation in key vulnerable sectors: mainstream adaptation measures into EU policies and programmes, as the way to 'climate-proof' EU action. This has already been mainstreamed in sectors such as marine waters, forestry and transport, but there is a need to increase the focus on adaptation. This will ensure better resilience in Europe's infrastructure and in at-risk sectors such as agriculture, fisheries, and furthermore improving cohesion policy and promoting the use of insurance against disasters (ibid).

3.3.6.2 *The Environmental Impact Assessment Directive (EIA) (2011/92/EU) and The Strategic Environmental Assessment Directive (2001/42/EC)*

The Environmental Impact Assessment Directive was passed by the European Parliament and Council and have obligatory assessments on a semi-regular basis, of which the last took place in 2011 (European Commission, 2017e). The European Court of Justice 'plays an important role in the implementation and interpretation of the EIA Directive' (European Commission, 2013c), to ensure its objectives are achieved in every Member State (ibid). The aim of the Directives is to ensure that plans, programs and projects that could have effects on the environment are assessed in terms of possible environmental impacts before they are authorized and implemented; examples being new large-scale agricultural farming projects. They intend to reduce risks in environmental disasters caused by manmade pollution.

The Protocol on Strategic Environmental Assessment augments the Espoo Convention by ensuring that individual Parties integrate environmental assessment into their plans and programmes at the earliest stages, and thus help in laying down the groundwork for sustainable development and CCA. The Protocol entered into force on 11 July 2010, transposing the protocol in EU legislation (European Commission, 2016a). The Directive includes the drawing up of an environmental report in which the likely significant effects on the environment and the reasonable alternatives are identified, and the carrying out of consultations (with the public, the environmental authorities, and with other Member States in the case of transboundary impacts). The environmental report and the results of the consultations are taken into account before adoption. Once a public plan and programme (P&P) is adopted, the Directive states that the environmental authorities and the public are to be informed and relevant information is made available to them. In order to identify unforeseen adverse effects at an early stage, significant environmental effects of the P&P will be monitored under the Directive (ibid). Environmental assessment can in turn be undertaken for individual projects, such as a dams, motorways, airports or factories.

The common principle of both Directives is to ensure that plans, programmes and projects likely to have significant effects on the environment are made subject to an environmental assessment, prior to their approval or authorisation. Consultation with the public is a key feature of environmental assessment procedures. The Directives on Environmental Assessment aim to provide a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation of projects, plans and programmes with a view to reduce their environmental impact (European Commission, 2017f)

3.3.6.3 *State of Play in the CCA Strategy*

The official review of the EU Adaptation Strategy is currently being foreseen by the European Commission and shall be published in 2018, but in February 2017 an own-initiative opinion was released entitled ‘Towards a new EU CCA strategy – taking an integrated approach,’ providing an update on the progress of the strategy. The report stated that results are beginning to show with the adoption of National Adaptation Strategies in 75% of EU Member States and the launch of the Mayors Adapt initiative. The report also stated that it may be necessary to ‘develop scenarios for adaptation to a temperature increase which is not limited to 2 degrees, if global efforts in the context of the Paris agreement are not successful’ (European Commission, 2017c).

An external policy brief by the *Bottom-Up Climate Adaptation Strategies Towards a Sustainable Europe* (Base-Adaptation, 2014) in 2014 on the ‘processes for design, implementation and review’ of climate adaptation strategies in the EU, stated that the ‘importance and influence of the EU in encouraging and shaping adaptations strategies amongst Member States is apparent’ (ibid). They highlight specifically the adoption of national adaptation strategies (NAS) by individual companies, of which are found to be in alignment with many of the strategies components, such as the principles outlined in the ‘Guidelines on developing adaptations strategies’. They give examples of the creation of the Italian and Czech NAS’ and the Finnish NAS timing future process so ‘as to be able to incorporate the guidance of EU Adaptation Strategy once adopted’ (ibid). Overall, it seems that change and progress has been made in terms of adaptation by Member States in terms of mainstreaming and NAS’. However it will be hard to say to what extent these changes have been successful until next year’s formal review.

3.3.6.4 *Climate Change Agreements in the Pre-Paris Era*

As the EU has aptly entitled the process, the ‘Road to Paris’ began long before the 2015 COP21 conference. The UN Framework for Convention on Climate Change and the Kyoto Protocol meet once a year to discuss combating climate change (European Commission, 2014b). It began in 2009, with the Copenhagen or COP 15, of which is a non-binding document, negotiated by leaders of over 30 countries. It was not adopted as a UN decision, although it as been endorsed by 140 UNFCCC Parties (European Commission, 2017c). In January 2009, the European Commission released a position paper ‘towards a comprehensive agreement in Copenhagen’, pushing for ‘binding emission reduction commitments should not be limited to the countries that have targets under the Kyoto Protocol’ (European Commission, 2009). The key elements from Copenhagen were further formalised in Cancún in 2010. Here, it was acknowledged for the ‘first time in a formal UN decision’ that global warming must be kept below 2°C, comparable to pre-industrial temperatures (European Commission, 2017c).The agreement entailed established ‘rules for monitoring, reporting and verification (MRV) of emissions and of climate finance’ (ibid). Another major aspect of the agreement was the commitment of developed countries, with the EU playing a major role, to provide almost US$ 30 billion in ‘fast start finance’ over the years 2010-12, to assist developing countries. The Green Climate Fund was also established alongside ‘new structure and institutions to enhance support’ to developing states, such as technology transfer, adaptation and tropical deforestation (REDD+) (ibid).

Proceeding this in 2011, The Durban Platform for Enhanced Action was set up to ‘negotiate a new global legal framework’ for all countries by 2015. The aim of this Platform was to build on and operationalise the Cancún Agreements, such as ‘a new market-based mechanism to enhance cost-effective emissions cuts… to consider climate issues related to agriculture’ (ibid). Closely followed in 2012 by the Doha agreement, finalising details of the 2nd period of the Kyoto Protocol. Here a work plan for negotiations on the ‘new’ global agreement was agreed (European Commission, 2017c), with a view of operationalising ‘the technology mechanism established in Cancun’ and launching the market mechanism programme established in Durban (ibid).

Moreover, the Warsaw 2013 conference agreed a timeplan for countries to ‘table their intended contributions for the new global climate agreements’ and ways to accelerate these efforts prior to 2020 (ibid). The conference also set up a mechanisms to address ‘losses and damage’ caused by climate change in vulnerable regions and countries. It also sought to enhance already agreed measures such as REDD+ (ibid). Immediately prior to the Paris Agreement, there was Lima in 2014, which ‘required all countries to describe their intended contributions for the 2015 agreements ‘clearly, transparently and understandably’ (ibid) also agreeing on draft elements for the agreement.

The EU has often been at the forefront of these international efforts to tackle climate change (European Commission, 2014

), stating in many press releases and reports that they are seeking 'legal force… through robust rules and institutions' (ibid) and binding agreements. The EU has always put forward consistent agendas in terms of reducing emissions and staying 'below the 2 degree target' (ibid), submitting contributions to each annual UNFCCC meeting. The Union has therefore been a crucial actor in global climate change negotiations, pushing the agenda and importance of international agreements and increased global collaboration regarding the challenges the world is facing.

3.3.6.5 *The Paris Climate Change Agreement (COP21) and the EU*

The Paris Agreement was a 'culmination of years of efforts by the global community' especially the EU, to codify a universal, multilateral agreement regarding climate change (European Commission, 2017b). Created in December 2015 during the Paris climate conference; 195 countries adopted the first-ever universal, legally-binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C. According to the European Commission's website, the EU has been at the forefront of international efforts towards a global climate deal (ibid). Following limited participation in the Kyoto Protocol and the lack of agreement during the climate conference in Copenhagen in 2009, the EU has been building a broad coalition of developed and developing countries in favour of high ambition that shaped the successful outcome of the Paris conference. The EU was the first major economy to submit its intended contribution to the new agreement in March 2015 and is already taking steps to implement its target to reduce emissions by at least 40% by 2030. The EU ratified the agreement in October 2016 (European Commission, 2016).

In the 2016 report *'The Road from Paris'*, the Commission outlined their commitment to the Paris Agreement and how it will be implemented. The report also highlighted two key focal points: 'fostering an enabling environment for low carbon transition' (European Commission, 2016) and meeting 'the 2030 European Council climate and energy policy framework', to reduce greenhouse gas emission by 2030. Alongside this, the 'Integrated Approach' opinion report from February 2017 by the European Commission Hertell (2017), highlighted the Commission's need to embed their action further into global frameworks and 'reinforce its exemplary role as well as to help build the synergies between them' (ibid). The report later highlighted how the official Climate Adaptation Strategy review to be published in 2018, shall better 'reflect on the transboundary aspect of the climate risk management issue' (ibid) emphasizing the significance of the Paris Agreement to the EU strategy.

The European Union follows a model of multi-level governance on climate change, and has focused on "multi-level reinforcement" on the issue. This way of governing in turn in-habits certain paradoxes which furthermore affects its approach on climate change adaptability measures, particularly in terms of binding agreements. The EU represents a unified body internationally, but the nature of the union having 28 sovereign member states inevitably pose a challenge when concrete adaptation measures and policy coordination is to be developed. The EU has therefore set ambitious targets in terms of CCA, but is constrained in its policy instrument choices - and it's high ambition on policy innovations and intentions are in contrast with its ability to implement them through sufficient EU legislation (van Asselt et al., 2012). This is exemplified in its multitude of policy documents, white papers and non-binding agreements on CCA (such as the 2013 Climate Change Adaptability strategy) but with the lack of the opposite. New and more efficient ways of approaching CCA could help with this challenge, and recent years has seen an increase in different ways of conducting DRR and CCA.

3.3.6.6 *Ecosystem- Based Approaches*

Among many approaches with regard to CCA, we found there to be an increasing focus in literature on the Ecosystem-Based Approach. This is an approach to adaptation that builds on people-based/community-based adaptation using participatory methods to address CCA, where societies and people play an instrumental role in CCA strategies and the measures taken. In comparison to people-based approaches, EbA places a stronger focus on ecological and natural solutions involving people using ecosystem services for adaptation. More conservation, restoration and sustainable use of ecosystems leads to improved resilience by vulnerability being reduced, which furthermore helps people adapt to climate change. Examples include how conservation of natural salt marshes and barrier beaches provide protection from disasters such as flooding and storms, how green spaces in cities improve air quality and decrease pollution, and how afforestation increases forests' resilience towards effects of climate change (International Institute for Environment and Development, 2017).

The research centre, Ecologic Institute EU, conducted in 2014-2015 a study on more than 200 project and initiatives following an Ecosystem-Based Approach in Germany, Austria and Switzerland to assess its benefits and efficacy as adaptation to climate change. Results showed a multitude of benefits of EbA, such as the approach being less dependent on advanced technology, thus less capital-intensive and more cost-effective. The main problem is that the benefits of the EbA approach are not sufficiently being disseminated to policy-makers, leading to the approach not being mainstreamed and used in adaptation measures (Ecologic Institute, 2015). The German Federal Enterprise for International Cooperation, GIZ, launched in 2015 called “Mainstreaming EbA - Strengthening ecosystem-based adaptation in planning and decision-making processes”, with the aim of collecting and refining concepts and methodologies that can be applied in existing adaptation measures, as well as defining training criteria and quality of EbA adaptation. The project is to run until 2018, and will establish concrete instruments geared on mainstreaming EbA, and develop different formats to increase the knowledge of EbA among decision-makers GIZ (2015).

3.4 National

This section provides sumamries extracted from the six national perspectives on existing legal/policy and science approaches. Each national perspective includes a brief review of the country's hazard profile, and a description of the existing legal/policy and science approaches based on the anlaysis if data that was collected as detailed in section 2.3. Accordingly, the details provided below do not necessairy give the full picture on identified countires but a snap shot. Further, this section provides only a summary of key national policies. Full national reports that were developed around (Italy, Germany, France, Switzerland, The UK and Denmark) as input papers are aviable as the annextures.

3.4.1 Italy

Italy is a land with a very diverse, extremely complex and jagged geography. Its political boundaries, for the greater part, correspond to its natural boundaries: The Alps in the North side, (neighbouring France, Switzerland, Austria and Slovenia), and the three seas – Adriatic, Ionic, Tyrrhenian – in the East, South and West side. Two great islands, Sicily and Sardinia, are integral part of the Italian nation. The total area of the nation is about 300.000 km², embracing 60.000.000 inhabitants, 8.094 municipalities, 110 provinces and 20 regions. Its maxim longitudinal extension is 1200 km (from the White Mount to Lampedusa Island) and its coastline is 7.375 km long. Table 3 summarises the key legal/policy and science approaches in the Italian context, representing a snap shot (input report on Italy is attached as the annexture 01).

Table 3- legal/policy and science approaches in the Italian context

Existing legal/policy and science approaches	Name/Number	Key Function
Legal/Policy approaches in relation to DRR	1. Law 996/1970	First regulation defining an overall framework of civil protection interventions. This law considered the emergency phase and outlined an embryonic system of civil protection organised around the National Fire and Rescue Service.
	2. Law 938/1982	Formalised the figure of the minister for coordinating civil Protection and the Service Order of April 29, 1982 established the Civil Protection Department, an extra ministerial organisation supporting the minister and capable of coordinating all the forces which the Country may avail of.
	3. Law 225/1992	Established the legal framework of the national civil protection organization, marking the birth of the modern Italian Civil Protection system and defining the main features of the Disaster Management approach in Italy
	4. Bassanini law (legislative decree 112/1198)	Strengthened decentralization and transferred to the local authorities' tasks not specifically assigned to the central system.
	5. Constitutional law 3/2001	Made the Civil Protection a competence matter of the Regions, by adding it amongst the subjects of "concurrent legislation". Significantly, the regional governments are entitled to building up their own civil protection structures matching the specificity of the territory and risk characteristics.
	6. Law 401/2001	Introduced the so-called "great events" in the competence of the Civil Protection Department and extended to such events the use of extraordinary power normally employed in state of emergency
	7. Law 100/2012	Most recent reform of the Civil Protection system. The structure of the system remains basically that defined by the law 225/1992, but important changes have been introduced, particularly regarding the definition of civil protection activities, the declaration of the state of emergency, and the issue of orders.

Science approaches in relation to DRR	1. The systematic assessment of **landslide/flood** hazard, risk, and vulnerability	Performed by the river/district basin authorities, regions and autonomous provinces which provide plans based on hydrogeological hazards maps (Law 183/89, Law 267/98, Legislative Decree 152/06, Legislative Decree 49/2010). The evaluation of flood and landslide risk is conducted at the level of each hydro-graphic district in those areas where the hazard maps together with information on land use and a vulnerability assessment show that potential risks from landslides or floods are significant.
	2. The CNR-IRPI and the CIMA Foundation (International Environmental Monitoring Center)	CIMA conducts activities for the adaptation, maintenance and upgrading of systems for collecting, treating and sharing hydropluviometric information and forecasting system for the hydrological weather monitoring in real time. It also conducts supporting activities and technical-scientific and operational assistance to the system of the National Meteorological Radar Network and the Central Functional Center.
	3. **Seismic Risk** emergency planning and management are conducted mostly at the national level by the Civil Protection Department, jointly with INGV (the National Institute for Geophysics and Volcanology), and other agencies or Competence/Functional centres (see National Report – ITALY, pp. 18-22)	The National Civil Protection Department (DPC) is in charge of the emergency management for events of type "C" (national emergency, as for earthquakes in Umbria-Marche, L'Aquila, Centro Italia), supported for scientific advice by the Great Risks Committee, which involves representatives from the DPC's Competence/Functional centres (see National Report – ITALY, pp. 18-22). INGV is the institution which has produced the national seismic hazard map (National Ordinance 3519/2006) and is in charge the seismic surveillance of the Italian territory. Regional and local emergency planning and management procedures are also in place.
	4. **Volcanic risk** emergency planning and management are conducted mostly at the national level by the Civil Protection Department, jointly with INGV (the National Institute for Geophysics and Volcanology) and other agencies or Competence/Functional centres (see National Report – ITALY, pp. 18-22)	Warning levels are set following official decision of the Great Risks Committee, which involves representatives from the DPC's Competence/Functional centres (see National Report – ITALY, pp. 18-22), based on the analysis of geophyisical and geochemical parameters from the monitoring network, when variations indicating the reaching of alert tresholds are observed. National emergency plans have been drawn up, which describe the characteristics of the monitoring system and the procedures according to the level of alert.
Legal/Policy approaches in relation to CCA	1. The Italian Ministry for the Environment Land and Sea (IMELS)	Responsible for the adoption of the National Strategy on Adaptation to Climatic Change
	2. Inter-Ministerial Committee for Economic Planning (CIPE)	Collective governmental body chaired by the President of the Council of Ministers, has competences related to climate change
	National Strategy on Adaptation to Climate Change (NAS) and National Adaptation Plan (NAP)	On 16th June 2015, Italian Ministry for the Environment, Land and Sea (IMELS) formally approved NAS and currently the NAP is in progress to implement the NAP. The NAS responds to the broader goals set out in the adaptation strategy package adopted by the European Commission in April 2013,

		with the aim of making Europe more climate-resilient. It provides a National vision to address CCA, actions and guidelines to build adaptive capacity, and concrete proposals about cost-effective adaptation measures and priorities.
Science approaches in relation to CCA	1. The Italian National Institute for Environmental Protection and Research (ISPRA)	Developed a computerized system called SCIA (www.scia.isprambiente.it) in order to optimize the use of instrumental data for climate knowledge and climate change assessments and building a bridge between climate research and societal sectors involved in climate change impacts.

Italy is vulnerable for several types of natural disasters. Since the country is located between two tectonic plates – Euro Asiatic and African plate – Italy is characterized by a high seismic risk and the most affected nation in Europe. Further, Italy is vulnerable for variety of volcano's typologies and the characteristics of the surrounding context pose diverse risk conditions, mainly in Campania and Sicily regions, but with potential effects all over Italy and Europe in case of large eruptions. The hydrogeological risk in Italy represent the greatest source of physical, economic and social impact. The national area classified with high level of hydrogeological risk cover 47.747 km² (15,8% of the total Italian area), divide in landslides area (23.929 km²) and flood area (24.411 km²). Air and water pollution constitute a severe problem in Italy, with aggravating factors related to the anthropization and industrial uses of the territory. Air pollution affects especially big cities, in particular the ones of the Po Valley, where exchanging among air masses are slower and where, in winter, the phenomena of temperature inversion occurs. In addition to above, further environmental issue concerns the forest fire risk, affecting the Mediterranean vegetation (Macchia) in the warmer months, when aridity, high temperatures and strong winds evaporate a part of the water held back by the plants, bringing about natural favourable conditions for fires to break out and spread.

3.4.2 **Germany**

Compared to many countries in the world, Germany is not heavily affected by natural disasters. Nonetheless, this does not mean that it is free from the adverse impacts of such events. According to EM-DAT, between 1900 and 2016, 73 events have occurred. Storms, floods and extreme temperatures are main hazards that have affected the country. As EM-DAT (2015a) reveals during the period of 1990- 2016, 9730 fatalities were recorded. Out from that 9730 over 9000 of fatalities were recorded from the August 2003 heatwave. With regard to economic losses, floods have resulted in the greatest economic losses in the recent past, with the "centennial" August 2002 flood being the worst event causing total losses of EUR 11.6 billion. In May/June 2013, another severe and widespread river flood occurred leading to total losses of around EUR 8 billion (Thieken et al., 2016). In May/June 2016, severe surface water flooding occurred at several locations and was partly accompanied by flash floods and debris flows, resulting in overall losses of EUR 2.6 billion (Munich Re 2017), an unprecedented amount caused by surface water flooding. In addition, storms are frequently causing damage. The most recent and expensive examples are the winter storm "Kyrill" in January 2007 causing an interruption of almost the entire railway network in Germany and losses of EUR 4.2 billion (Munich, 2017) and hailstorms in July 2013 that hit some cities in Baden-Wurttemberg and Lower Saxony causing total losses of EUR 3.1 billion (GDV, 2014).

Germany has three layers of legal and policy and science approaches to deal with the DRR and CCA context which are the national level, federal state level and the municipal level. According to the Basic Constitutional law (GG, Article 73 Paragraph 1 Number 1), the federation is responsible for the protection of the population against war and other military conflicts. In all other cases the federal states (Länder) are responsible. As a reaction to the terrorist attacks of 9/11 and the massive Elbe flood in 2002, the Standing Conference of the federal and state interior ministers adopted the "New Strategy for Protecting the Population" („Neue Strategie zum Schutz der Bevölkerung in Deutschland") the same year. This strategic framework was to strengthen the collaboration between federation and federal states in dealing with extraordinary, large-scale or nationally significant threats and damage. With this framework, the German government intended to review and renew the system of civil protection to prepare the system for current challenges - including climate change. Table 4 and 5 summarise the key legal/policy and science approaches in the German context representing a snap shot (see Annexture 2 for the input report on Germany).

Table 4- Legal/policy and science approaches in Germany (part 1)

	Name/Key Legal Body/Institution	Key Function
Legal/Policy approaches in relation to DRR	Federal Office of Civil Protection and Disaster Assistance (BBK)	Created a central organisational element working to ensure the safety of the population.
	Federal Civil Protection and Disaster Assistance Act	Established a legal basis for the fact that the whole of society shares responsibility in case of large scale damage that crosses the borders of federal states
	Federal Ministry of the Interior	Responsible for security matters (public security, data security, internal security, protection against disasters and terrorism). It plays a central role in managing crises taking place within the country and hosts the Standing Committee of Interior Ministers.
	Academy for Crisis Management, Emergency Planning and Civil Protection (AKNZ)	Forms Division IV of the BBK and is the central educational institution of the federation regarding risk and crisis management as well as civil protection.
	German Federal Agency for Technical Relief	Provides technical relief under Section 1 (2) of the Act on the Federal Agency for Technical Relief (THW-Gesetz) in accordance with the Federal Civil Protection and Disaster Relief Act.
	Federal Water Act, WHG) which was originally adopted in 1957 (revised 2010) And German Flood Protection Act 2005	A shift towards a more integrated flood-risk-management system in Germany that also considers non-structural measures to minimize adverse effects of flooding
	National Statergy to Protect Critical Infrastructure (CIP)	Defines Critical Infrastructure as "organizational and physical structures and facilities of such vital importance to a nation's society and economy that their failure or degradation would result in sustained supply shortages, significant disruption of public safety and security, or other dramatic consequences

In addition to the federal level, since the responsibility for disaster management in terms of civil protection lies with the "Länder", each federal state`s government has the right and responsibility for policy formulation in the area of civil security, typically through its Ministry of the Interior. The departments of the interior on federation and federal state level meet regularly to coordinate their activities.

When it come to the municipal level, even though the federal states have the legislative and executive power according to the Basic Constitutional Law (GG, Article 83), disaster relief is to a large extent planned and implemented on a local level.

Table 5 summarises some of the key legislations in relation to CCA,

Table 5- Legal/policy and science approaches in Germany (part 2)

	Name/Key Legal Body/Institution	Key Function
Legal/Policy approaches in relation to CCA	The German strategy for adaptation to climate change	Established in 2008 as a framework for a medium-term national adaptation process
	Adaptation action plan 1 and 2	APA 1- underpinned by the objectives and options for action, defining specific activities as detailed in the DAS and linking it with other national strategy processes. APA 2- This plan presents future actions of the federal government as well as a concrete time and financing plan. APA II are organized along specific fields of action or clusters, e.g. “water”, “infrastructures”, “land”, “health”, “business” and “spatial planning and civil protection

In addition, Germany has several research support institutions and scientific approaches in relation to DRR and CCA as detailed in the German National report which was completed as an input report for this report.

3.4.3 France

France is divided into 18 administrative regions, including 13 metropolitan and 5 overseas regions. Mainland France covers 550,000 km^2 in addition to 120,000 km^2 of overseas territories. Metropolitan France is bounded by the Atlantic Ocean in the North and West and the Mediterranean Sea, in the South (in total, France counts with almost 3.430 km of maritime frontiers). Major landforms are the Alps (East, South-East) and the Pyrenees (South, South-West). In the North and West, the terrain is mostly flat plains or gently rolling hills while the South is mountainous.

According to (CRED/EM-DAT), France is vulnerable for eight major natural hazards, namely, storms and cyclones, river floods, earthquakes, volcanic eruptions, landslides, avalanches, forest fires and heat waves. The earthquake and volcanic hazard pose a major threat in the overseas territories, in particular Guadeloupe and Martinique.

France is particularly vulnerable to the perils of storms, flooding caused by watercourses overflowing or by runoff and floods caused by mountain torrents. Mediterranean flash floods trigger 66% of the damage due to flooding in France. Overall, flood hazard zones extend over approximately 27,000 km^2 and expose about 5.1 million people (16,000 communes) to this hazard.

France has a high exposure to the risk of coastal flooding. 40% of metropolitan France’s 7,000 km of coastline is considered to be highly vulnerable because of the topography (“mobile” coastline). This means in effect nearly 2,800 km of coastline with high and ever-increasing levels of economic assets, both on the Mediterranean shores and the coastline from Biarritz to Dunkirk. In the Antilles, the seismic hazard is the most feared risk for the foreseeable number of victims.

More than two thirds of the 36,000 municipalities in France are at risk from at least one natural disaster and almost one inhabitant in four and one job out of three is potentially exposed to flood risks, the main hazard in France for the number of affected people and the economic cost of the disaster.

Since January 2001, 1,391 natural hazard events were registered with an associated death toll of 25,193 people, mostly due to heat waves mortality, and over 27 billion Euros of damage in Metropolitan France and overseas departments.

A snapshot of the existing legal/policy and science approaches of France in relation to DRR and CCA are summarized in the table 6 (see Annexture 3 for the input report).

Table 6- Legal/policy and science approaches in France

	Name/Key Legal Body/Institution	Key Function
Legal/Policy approaches in relation to DRR	General directorate for civil security and crisis management (DGSCGC)	In charge of the preparation and implementation of emergency measures that are necessary to population safeguard. The law of modernisation of civil security, in 2004, has defined the principles of civil security.
	Law, dated 28 May 1858	Key DRR law which is under the environment code. Initially, this aimed at protecting towns against inundation. Its general principle was to reduce the territories exposure to flood risk, while maintaining the capacity of the river discharge. This legal framework, initially centred on inundation has slowly evolved up to the last quarter of the 20th century, involving other natural hazards. Currently, this DRR policy relies on a legal, operational and financial arsenal including: • Tools to improve knowledge about risk and elements at stake which have been enriched recently by the European flooding directive • Risks prevention plans (PPR) from the 1982 law, and more recently, action plans for flood prevention (PAPI), City safeguard plans (PCS), etc. • Specific financing schemes, from the CAT NAT insurance contribution which complements the essential input of local public or private actors, as defined by the 1995 law.
	The state administration (Government), namely the Prefet of the department has the responsibility of defining the risk within the legal framework defined by the Ministry in charge.	It identifies the town territories at risk and informs the concerned local authorities. Afterwards, it prescribes the preparation of the risk prevention plan (PPR) on the territories at risk and, after consultation with the local stakeholders, it endorses the plan.
	The local authority, mainly the Mayor	Has to implement the risk prevention policy on its territory, as it is responsible for urban planning and for citizen security. This means: introducing PPR prescriptions into the local urban development plan
	Articles L125-2 and followings of the environmental code	Describes the right for the citizen to get information on major risk to which people exposed and the duty for authorities to inform people.
	Law No. 82-600 of 13 July 1982, as amended, relating to compensation for victims of natural disasters, Article L 125-1 of the Insurance Code	A risk transfer system, based on solidarity between all insured stakeholders. It is called the Natural Catastrophes system (Cat Nat), relying on a tax on insurance contracts (12% for housing, 6% for vehicles). This fund represents the State guarantee and is managed by a public re-insurance fund (CCR).
	Law Nr 2014-58 dated 27 January 2014 on the modernisation of territorial public action	The responsibility of the local authorities with respect to the risk prevention has been specified by the law reorganising the local governance structures (MAPTAM

Legal/Policy approaches in relation to CCA	The National strategy on CCA (SNACC)2013	Completed by a National plan on CCA (PNACC) for 2011-2015. It is followed by the National Observatory of the Effects of Climate Warming (ONERC)
	The National strategy on Global Integrated Coastline Management (SNGITC)' 2014	Emphasis on the consequence of climate change on the sea level. An important tool for the follow-um of this strategy is the National Observatory of Sea and Coastline (ONML)
	The Risk prevention plans for natural hazards (PPRn) based on the 1982 law	This policy was initially build around the river flood risk, but, currently, this policy has progressively aggregated other natural risks (earthquake, landslide, storm surge, marine submersion).

3.4.4 Switzerland

Switzerland is a land-locked country, bordered to the north west by the Jura mountains and to the south by the Swiss Alps, its central plateau lying between. It shares its borders with 5 other European countries- France, Italy, Liechtenstein, Germany and Austria.

Switzerland has high fluctuations in relief, ranging from the central lowland plateau a few hundred metres above sea level, to 4500m+ peaks. Switzerland's mountainous regions are vulnerable to a wider *range* of natural hazards than its Central Plateau. Associated hazards in these high relief areas, include avalanche, rock fall, debris flows and landslides, exacerbated by higher erosion rates in steep terrain. Floods also pose a nation-wide threat due to high (and increasing) precipitation and periodic high run-off from upland areas sometimes causing build-up stresses further downstream. Switzerland has a vast watercourse network, whose combined length totals around 65,000 kilometres, and due to extreme differences in altitude over a relatively small area between the Alps and Central Plateau, floods can occur almost everywhere in Switzerland. In warmer periods, when seasonal snow and glacier melt in the Alpine region coincide with intensive storms, prolonged rainfall or orographic precipitation, rivers and lakes may break their banks and can flood valley plains (FOEN, 2015). Intermittent, heavy snowfall and unstable snow pack can create a risk of avalanche at high altitudes, while heavy rainfall during the warmer seasons can trigger landslides and debris flows.

Switzerland has several institutions which have the legal mandate and the power to prepare and implement policies in relation to DRR and CCA. Following are the key organisations involved in DRR and CCA in Switzerland. Detailed review of the existing legal/policy and science approaches are described in the Swiss National input report (Annexture 4).

- **Federal Office for the Environment (FOEN):** FOEN is responsible for water-related disasters such as floods and debris flows, landslides, rock fall and avalanches. Storms and forest fires as well as coordination of the federal earthquake mitigation program also fall under FOEN's responsibility.
- **Federal Office for Civil Protection (FOCP):** responsible for protection of the population in cases of catastrophes and emergencies. FOCP is responsible for risks that are of national importance (such as increased radioactivity, satellite crashes, dam bursts, epidemics and armed conflicts). It is also responsible for national risk analysis for disasters and emergencies in Switzerland.
- **Federal Office for Spatial Development (ARE):** plays a key role in providing national guidance for a hazard-informed spatial planning approach and determining fundamental rules
- **Federal Office of Meteorology and Climatology (MeteoSwiss):** Climate-related and meteorological hazards, such as heatwaves or cold snaps lie in the responsibility of the Federal Office of Meteorology and Climatology.
- **Swiss Federal Institute for Forest, Snow and Landscape Research (WSL):** strives for excellence in terrestrial environmental research to provide solutions improving quality of life in a healthy environment.
- **Federal Roads Office (FEDRO):** Plays an important role in guaranteeing roads and motorways remain functional or become functional again during and after disasters.
- **Swiss Seismological Service (SED, Erdbebendienst):** Federal agency responsible for monitoring earthquakes in Switzerland and its neighbouring countries and for assessing Switzerland's seismic

hazard.

- **Institute for Snow and Avalanche Research (SLF)：** assesses avalanche danger in the Swiss Alps and issues daily avalanche bulletins in the winter.
- **Bundesstab ABCN:** Switzerland's National Crisis Coordination Committee- identifies practical solutions for high impact, complex incidents.

3.4.5 The United Kingdom

The United Kingdom (UK) is an island country located off the north-western coast of mainland Europe. The UK comprises the whole of the island of Great Britain-which contains England, Wales, and Scotland-as well as the northern portion of the island of Ireland. England, occupying most of southern Great Britain, includes the Isles of Scilly off the southwest coast and the Isle of Wight off the southern coast. Scotland, occupying northern Great Britain, includes the Orkney and Shetland islands off the northern coast and the Hebrides off the north-western coast. Wales lies west of England and includes the island of Anglesey to the northwest. Apart from the land border with the Irish republic, the UK is surrounded by sea. To the south of England and between the UK and France is the English Channel. The North Sea lies to the east. To the west of Wales and northern England and to the southeast of Northern Ireland, the Irish Sea separates Great Britain from Ireland, while southwestern England, the north-western coast of Northern Ireland, and western Scotland face the Atlantic Ocean. At its widest the UK is 300 miles (500 km) across. From the northern tip of Scotland to the southern coast of England, it is about 600 miles (1,000 km). No part is more than 75 miles (120 km) from the sea. The capital, London, is situated on the tidal River Thames in south-eastern England. (Encyclopædia Britannica, 2017)

The UK faces a range of hazard threats. According to EM-DAT (2015b), during the period of 1990 to 2014, the most frequent disaster events were due to floods and storms. The highest mortality rate- 77.4% – is linked to extreme temperature and least number of mortalities are recorded due to flood. Flooding was responsible for ster which 63.1% economic losses resulting from disaster.

In the UK, the disaster management structure is established by an act of the Parliament of the UK - Civil Contingencies Act 2004 - that establishes a coherent framework for emergency planning and response ranging from the local to national level. The Civil Contingencies Secretariat (CSS) is the national platform for disaster management. It sits within the Cabinet Office at the heart of central government. It works in partnership with government departments, the devolved administrations (Scotland, Wales & Northern Ireland) and key stakeholders to enhance the UK's ability to prepare for, respond to and recover from emergencies. CCS has specific objectives ranging from disaster response to building greater resilience for the future.

The overall structure of disaster management has generally remained with the central government fulfilling the role of coordinator and providing guidance. The structure of emergency management in UK is decentralized. Most emergencies and incidents, based on scale or complexity, are handled at local level with no involvement of Central Government. Local agencies are always the first responders and the ones who carry the burden of emergency management. In most cases the police are considered one of the leading responding actors in local disasters (Secretariat Civil Contingencies, 2009).

The Climate Change Act is the principal legislative background in dealing with climate change in the UK. The Climate Change Act produces legislative background for both CCA and climate change mitigation. However, prior to introducing Climate Change Act in 2008, there were some other acts, bills, and efforts initiated in the UK focusing on climate change mitigation. Table 7 provides a snap shot of the key legal/policy and science approaches in the UK (see annexture 5 for the input report)

Table 7- Legal/policy and science approaches in the UK

	Name/Key Legal Body/Institution	Key Function
Legal/Policy approaches in relation to DRR	Civil Contingencies Act (2004)	Delivers a coherent framework for emergency planning and response ranging from local to national level. It also replaces former Civil Defence and Emergency Powers legislation of the 20th century. The Act, and accompanying regulations and non-legislative measures, deliver a single framework for civil protection in the United Kingdom capable of meeting the challenges of the twenty-first century. The Act is separated into two substantive

		parts:
	Flood and water management act 2010	Legislatory step towards improving both food risk management and the way to manage water resources in the United Kingdom It seeks to define clearer roles, responsibilities and standards for the creation of sustainable drainage. Whilst the act places primary responsibility for managing new regulations on Local Authorities, responsibility for the specification, design, implementation and maintenance of sustainable urban drainage systems (SUDS) schemes remains shared between local government, developers, land-owners and even home-owners.
	Local Government and Housing Act 1989 (revised 2011)-Provision 156 for DRR	Provide for a national code of local government conduct and to make provisions about certain existing grants and about financial assistance to and planning by local authorities in respect of emergencies.
	Flood Risk Regulations 2009	Sets out where and how to manage flooding so that communities and the environment benefit the most. Flood risk management planning is integral to the way risk management authorities (RMAs) work: it allows authorities to develop a shared understanding of risk from all sources of flooding and agree priorities with communities to manage that risk.
Science Approaches in relation to DRR	UK government office for Science- Reducing Risks of Future Disasters	The aim of this government initiative has been to provide advice to decision makers on how science can inform the difficult choices and priorities for investing in DRR, so that the diverse impacts of future disasters can be effectively reduced, both around the time of the events and in the longer term.
	The use of science in Humanitarian Emergencies and Disasters	A comprehensive assessment of the UK and the international community's current response to humanitarian emergencies.
Legal/Policy approaches in relation to CCA	Climate Change Act 2008	The legislative framework for both CCA and mitigation. The Act is considered as the world's first long term legally binding framework to address climate change, in accordance with the Kyoto Protocol
	The National Adaptation Strategy (NAS) and the National Adaptation Program (NAP) to Climate Change-UK	Aims to provide a coherent and coordinated approach to adaptation for the UK.
	Climate Change Risk Assessment	Under the provisions of the Climate Change Act 2008, the UK Government is required to publish a UK-wide Climate Change Risk Assessment (CCRA) every five years. The Act stipulates that the Government must assess 'the risks for the United Kingdom from the current and predicted impacts of climate change
Science approaches in relation to CCA	United Kingdom Climate Impact Programme (UKCIP)	UKCIP works across scientific research, policy making and adaptation practices by bringing wider range of stakeholders working in climate change. They provide consultancy services, conduct research and establish partnerships. They are interested in working with multi-stakeholders when developing adaptation strategies

3.4.6 Denmark

Denmark lies in the Nordic region of Europe. It is the smallest country of the Nordic states with the city of Copenhagen as its capital. Denmark has a long coastline of 7,314 km and the area of Denmark is 43,094 sq.km. It lies very close to Sweden and borders with Germany. Denmark is divided into five regions governed by regional councils.

The common disasters affecting Denmark include floods, storms, cloudbursts, terror attacks, oil spills. Some of the disasters in the recent years are- storm surge in January 2017; repeated floods in Southern Denmark in 2015; terror attacks in 2015; storms in 2013 winter; Copenhagen cloudburst in 2011 Eydal et al. (2016). In the coastal areas, hurricanes and storms lead to storm surges. A survey by the Danish Insurance Association in 2012, shows that the storm damages in the last five years had impacted approximately one in every 10 house owners (DEMA, 2013). The most recent disaster, the storm surge in January 2017 had the Danish Emergency Management Agency (DEMA) working with high capacity pumps to keep the water out of residential areas. The storm surge is estimated to have cost at least 10 million DKK for municipal preparedness (1,4 million Euros) (DEMA, 2017).

Every third year DEMA issues an overview of the biggest threats against Denmark. The latest was issued in the spring of 2017 and highlights 13 threats to Denmark. Besides the 13 threats the report points to four overall “trends” that might affect the risk landscape for Denmark: changes in geopolitical security, antibiotics resistance, irregular migration and increasing traffic in the Arctic theatre (DEMA 2017).

Denmark has chosen to take a high-profile strategy on CCA, and in particular costal municipalities of Denmark, have in recent years made large investments in city planning projects. These projects have close links to DRR (although not made explicitly) as most disasters faced by Denmark are water and climate related.

Table 8 provides a sanp shot of the key legal/policy and science approaches in relation DRR nd CCA (see Annexture 6 for the input report).

Table 8- Legal/policy and science approaches in Denamark

	Name/Key Legal Body/Institution	**Key Function**
Legal/Policy approaches in relation to DRR	Danish Emergency Managment Act 1992	The first Danish Civil Defence Act was introduced in 1949. The present legal framework for disaster risk management is the Danish Emergency Management Act from 1992. The aim of EMA is “to prevent, limit and redress personal injury and damage to property and the environment arising from accidents, disasters and catastrophes, including acts of war, or imminent danger of such.
	The Danish Emergency Management Agency (DEMA) was established in 1993	Three Levels, • Municipal level • Municipal support level • National level
	The national crisis management organization	Consists of two levels coordinating national-level emergencies: The Government Security Committee, and the Senior Officials' Security Committee. The committees function as a Matryoshka doll, all referring to each other upwards in the system. In principle, all decisions of importance regarding national security is taken by the Government’s security committee chaired by the Prime Minister of Denmark (after recommendation from the subjacent bodies). Furthermore, the Crisis Management Group (CMG) is a planning forum for continuos revision of the Danish crisis management system.

Legal/Policy approaches in relation to CCA	Climate Change Adaptation Strategy 2008 Municipal CCA Plans	This document outlined a range of policy options available for municipalities in implementing CCA, but did not impose any specific obligations. In conjuncture with the strategy the The Danish Portal for Climate Change Adaptation was established to document all relevant material on CCA (http://en.klimatilpasning.dk/) – and serve as resource database for individuals, municipalities and businesses. An obligation to develop municipal CCA-plans (*kommunale klimatilpasningsplaner*) as well as to make so-called climate-based district plans (*klimalokalplaner*) were introduced in 2012 (Denmark Government 2012). Accordingly, municipalities are obliged by law to specifically address the potential effects of climate change in all aspects of their city planning and development. Since 2012, every municipality accordingly had to carry out a risk assessment and specific actions.
	Danish Climate Change Act (2014)	The Act specifies -Establishment of an independent, academically based Climate Council. - An Annual Climate Policy Report. - Process for establishing new national climate targets.
Science approaches in relation to DRR & CCA	Government funding bodies	• Denmark's Development Cooperation is referred to as DANIDA- DKK 7.5 billion to support the fight against climate change (government funded) • The Danish Council for Independent Research (DFF)- open competition of all thematic and faculty areas (Medicine; Social Sciences; Natural Sciences).
	Some Research Centres on DRR and CCA science approaches	• Copenhagen Centre for Disaster Research (COPE): COPE is a cooperative network between University of Copenhagen and CBS to bring all disaster scholars in larger Copenhagen together as one network. COPE is part of the NORDFORSK-funded Nordic Centre of Excellence on Resilience and Societal Security (NORDRESS). • University of Copenhagen's Sustainability Science Centre aims to facilitate and coordinate research on sustainability issues. Among the Centre's work, one of the areas is climate change issues. • Department of Environmental Science; Aarhus University (research on CCA): Another example of Danish CCA research is at Aarhus University.

4 Key issues in the existing legal/policy and science approaches

This section identifies the key issues, including barriers and challenges that prevent effective DRR and CCA, including better intergration. These have emerged from an analysis of existing legal/policy and science approaches, drawing upon the national, EU and global perspectives described in Section 3.

4.1 Institutional arrangements

Institutional arrangements mean the institutional set-up to handle DRR and CCA. Under this, issues in the existing government structures to handle DRR and CCA are discussed including its legal/policy background for the formation of the current structures.

Institutional barriers are identified as a key challenge that hinders the process of successful integration of CCA into DRR (Sperling and Szekely, 2005, Schipper and Pelling, 2006, Gero et al., 2010). Institutional barriers are identified in terms of the structure of institutions (Sperling and Szekely, 2005). In most of the countries climate change related policies and decisions are made by the ministries and organisations related to the environment, whereas disaster management and reduction decisions are made by ministries related to infrastructure development. This institutional structure disturbs the communication process which generates an information barrier among the institutions. Also, as the DRR and CCA efforts are handled by two sets of organisations, their inherited cultures prevent or reduce the ability to integrate effectively UNISDR (2012), (Schipper and Pelling, 2006).

A key reason for this unstructured institutional arrangement is the lack of a proper legislation and institutional framework to integrate DRR and CCA.

For example as per the ESPREssO Italian National review, the National Department of Civil Protection, which is the key legal background for the implementation of DRR, does not have a specific mandate to deal with CCA. As a result, there is no direct relationship between DRR and CCA initiatives (Zuccaro et al., 2017).

ESPREssO Germany National reviw specifies that Germany faces the same challenge. CCA is mainly within the responsibility of the Environment Department, while DRR falls under the area of competence of the Department of the Interior (Mark et al., 2017).

As per the ESPREssO global review, in the United States, DRR and CCA are not integrated, either at the State or Federal level. At the Federal level, DRR and CCA responsibilities lie within different agencies. In the United States, responsibilities are split across the Department of Homeland Security, the Department of Defence, and the Department of Energy, creating a very fragmented approach (Amaratunga et al., 2017b).

Similarly, according to the same global review, most African countries have very diverse policies and strategies for implementing DRR and CCA, which then have a bearing on different institutional frameworks for implementation. As the strategies are different, the implementation modalities are also different, resulting in different budgetary allocations for different sets of institutions. This results in the lack of a common implementation framework (Amaratunga et al., 2017b) .

Integration of DRR and CCA is not a legal mandate in most countries. Many have legal provisions for civil protection as a mandate of DRR. Therefore, countries have short term plans for DRR or plans for disaster response and recovery, rather than a long term strategic plan to reduce disaster risk by integrating CCA. For example, as the ESPREssO German National Review specifies, in Germany, the harmonisation of DRR and CCA is not likely going be a priority for administrations dealing with civil protection at both federal states and municipal levels since they are busy with implementing the concept for civil protection, which is legally binding, while the integration of CCA in many cases is not (Mark et al., 2017).

Another key barrier to the integration of DRR and CCA, as well as for the functioning of these two disciplines, is the institutional communication from the state level to the local level. As the ESPREssO Swiss National review specifies, Countries like Switzerland have issues with the advisory flow of information down from the Federal Level to the Cantonal level. It is not always translated beyond to the municipal level where implementation is mostly likely to take place (Booth et al., 2017). This is a common issue in most of the countries where there are no legal/policy background which direct this top-down communication. Decisions are taken at the state level which are not translated to the local context where the implementation happens.

Considering DRR only as a discipline for disaster response and recovery in the respective countries' legal and policy mandate is another important barrier. Most of the countries have state level legislation for DRR but its focus is on disaster response and recovery. For example ESPREssO the UK national review states, in the UK, the Civil Contingencies Act is at the core of the disaster management approach, but it has limited focus on preparedness and capacity for adaptation. As a result of this context, the institutions in the UK for disaster response and recovery, DRR and CCA are typically separated (Amaratunga et al., 2017a). This situation is shared by most Asian countries as discovered in the ESPREssO global review, where DRR is a subject for disaster response. As a consequence, DRR and CCA are separate portfolios operated by different ministries (Amaratunga et al., 2017b).

However, it was clearly demonstrated from the ESPRessO national reviews as well as from the ESPRessO global review that the post 2015 agenda which is the SFDRR has a key focus on development oriented DRR and CCA. This means integrating DRR and CCA together and then integrating it to the development agendas of countries. This is considered as a way forward for sustainable development. The global analysis pertaining to Asia clearly demonstrates that post 2015 SFDRR has provided insights to the Asian countries to come out from the myth that 'DRR is disaster response and recovery'(Amaratunga et al., 2017a, Amaratunga et al., 2017b, Booth et al., 2017 , Lauta et al., 2017, Susanne et al., 2017 , Zuccaro et al., 2017) (Mark et al., 2017).

4.2 Funding arrangements

Funding is a common barrier to the integration of CCA with DRR (Sperling and Szekely, 2005, UNISDR, 2012, Urwin and Jordan, 2008, UNISDR, 2013a, Biesbroek et al., 2010). As UNISDR (2012) points out, funding for DRR is not equally allocated between relief, reconstruction and prevention. For example, for every $100 spent on disasters and risks, $96 of that is spent on emergency relief and reconstruction. This highlights the low financial arrangement for disaster reduction as preventive measures.

This study found that most countries do not have a specific legal or policy background for the allocation of funding for DRR and CCA. There is funding coming from different sources but it is not equally allocated for DRR and CCA.

There are some interesting findings from the UK context. In the UK, key funds are allocated only for disaster response not even for disaster recovery. As the Committee on Climate Change (2015) highlights, currently, most of the activities are limited by the government funded programme. As a result, in the event of a major disaster, contingency funds are available for immediate response activities only. Hence, there are no recovery funds made available by the government, local authorities to cover damages to the individuals and companies. Further, there are no specific policies to provide financial provisions for risk management planning (UNISDR EC OECD, 2013). Within the available funding schemes, there are many issues on funding allocations. One of the issues of the UK's DRR strategy is that there is no specific and comprehensive estimation of budget allocation for disaster risk reduction efforts (UNISDR EC OECD, 2013). As the ESPREssO the UK national review discovers, with recent budgetary controls in all sectors in the UK, the allocation for DRR programmes have been highly affected, within the available funding, funding for CCA is increasing and sizeable whereas funding for DRR is poor (Amaratunga et al., 2017a).

Figure 01 summarises the funding issue in UK with its relevant policy and legal context.

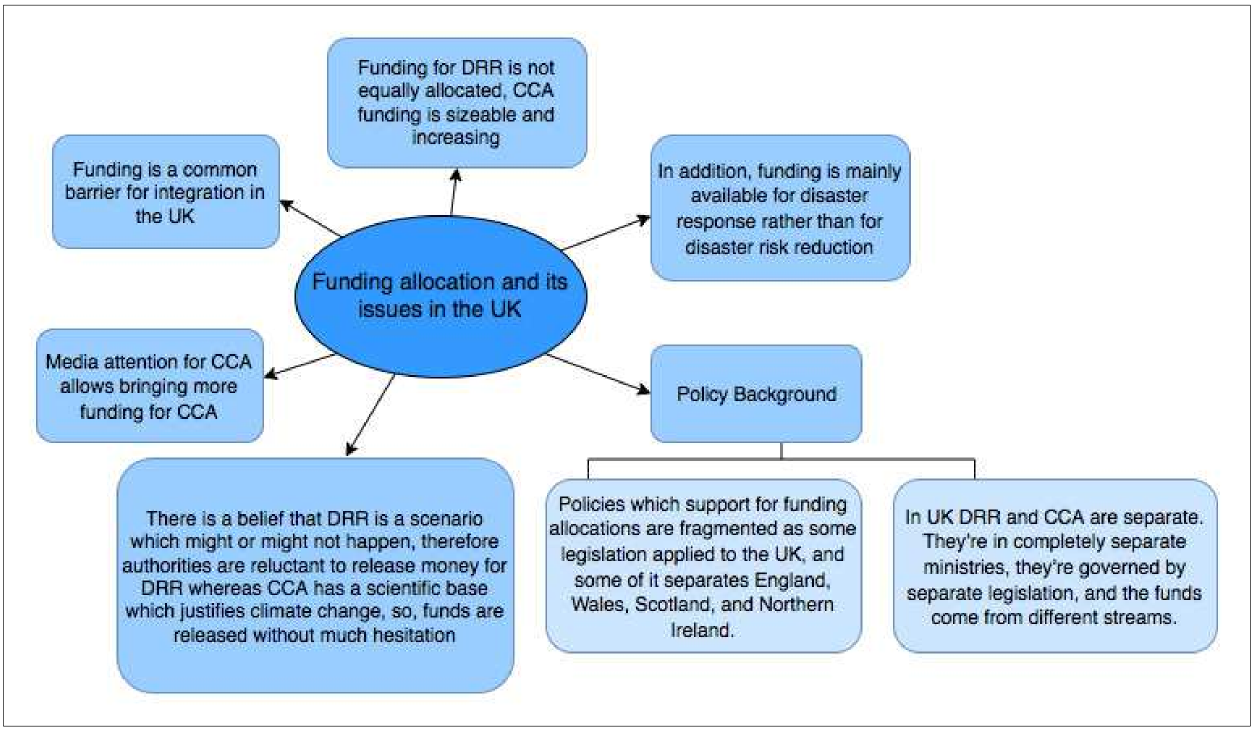

Figure 1- Funding allocations and issues in the UK,
Source- ESPREssO the UK national review (Amaratunga et al., 2017a)

Similar to the UK, many DRR programmes are funded by humanitarian budgets while CCA programmes are funded by environmental departments (Mitchell et al., 2010). Funding for DRR is ad-hoc and insufficient because humanitarian assistance fails to provide an adequate allocation for DRR, whereas funding for CCA is sizable and increasing (Mitchell and van Aalst, 2008). Most adaptation strategies do not have commitments towards financial resources due to a lack of knowledge on the cost of adaptation (Birkmann and von Teichman, 2010). However, this is not the case for some countries. As per the ESPREssO Italian national review states, Italy has sizeable funding for DRR but not for CCA. In Italy DRR funding is available at the state level under the Department of Civil protection, but for CCA it depends on the funding at the EU level (Zuccaro et al., 2017).

In the Danish context, CCA efforts are funded under a more complex funding structure. As CCA remains closely connected to construction and city planning in the Danish context, municipalities through public investments provide the main funding (Hellesen et al., 2010). This funding is often embedded in private-public partnerships or infrastructure investments. The municipalities have had a number of attractive regulatory incentives, placing climate investments outside the scope of the normal budget restriction on new construction projects – these have, however, been subject to change and discussion in recent years (Sørensen and Jebens, 2015).

Asia has the same issue as in the most of the countries CCA receives increasing and sizeable funding, whereas DRR is funded only within the humanitarian budget. Figure 2 which was derived from the ESPREssO Global review (Amaratunga et al., 2017b) summarises the issues in funding allocations in Asia,

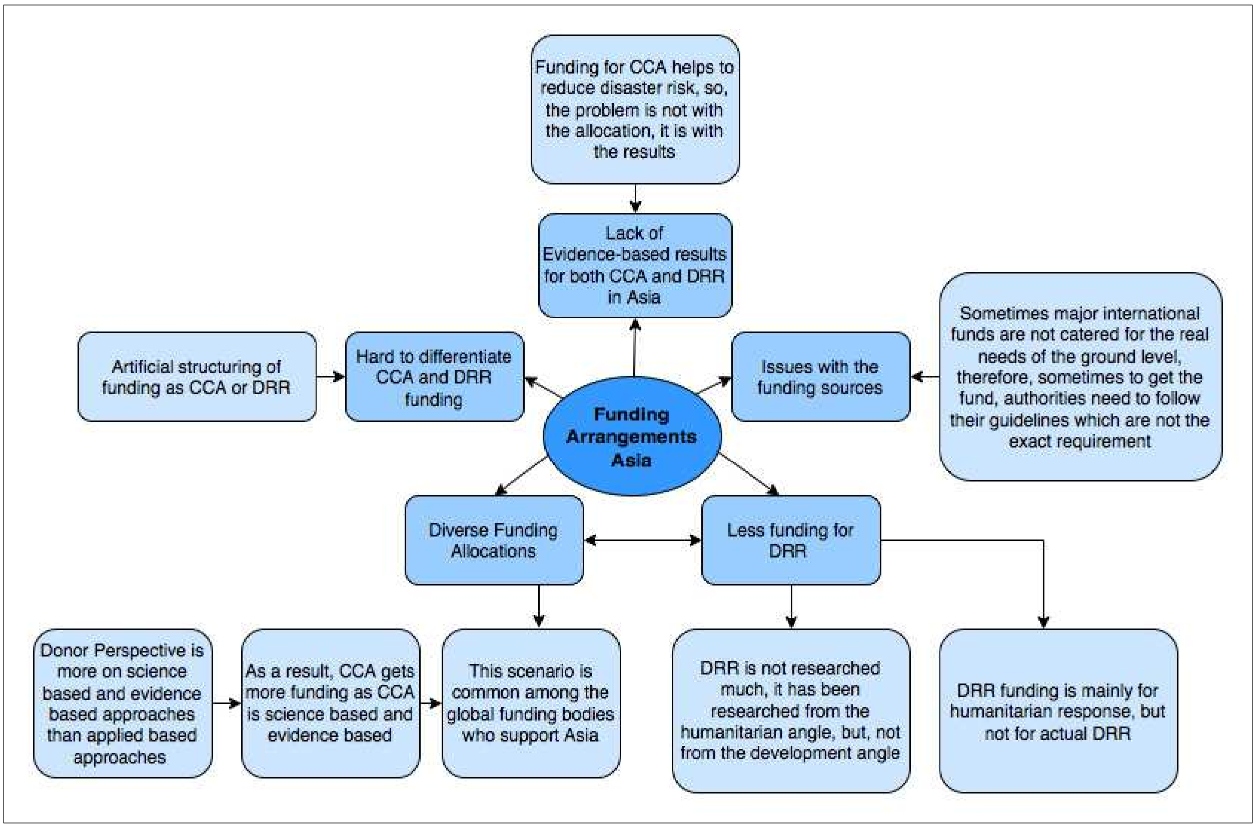

Figure 2- Funding Arrangements Asia
Source- ESPREssO the global review (Amaratunga et al., 2017a)

Even when there is increasing and sizeable funding for DRR or CCA, the issue is with the allocation of funding. Funding allocation is determined by the existing institutional structures. At the moment, the existing institutional structures and legal frameworks are diverse and therefore, funding are within different groups. Figure 2 specifies that in Asia there is an artificial structuring on DRR and CCA funding where as it is hard to differentiate whether the funding is for CCA or DRR. This issue is highlighted as a common issue in Africa as well. According to ESPREssO global review in Africa, the title of the funding proposal is changed as per the scope of the funder in order to get the particular funding. This suggests that both DRR and CCA are two disciplines which should come under one umbrella, rather than keeping them as two separate disciplines (Amaratunga et al., 2017b).

<u>Funding in the African region</u>

"I mean the first funding arrangements for both DRR and CCA initiatives would be the regular national budgets. But in the case of Africa where the majority of the countries are least developed countries, donor funding is equally important. In most of the countries the ODA allocation is a substantive proportion of the national GDB. So, for example, on the DRR side we have a series of donors who give the funding either to the Government or to the implementing agencies, including the UN and NGOs. And on the climate change side we have the Green Climate Fund for example where the member states have access to the climate financing. But the challenge here we often see is that, you know, in terms of the funding part, is that the funds are often earmarked to be either DRR or CCA and often I've seen the donor proposals or a project proposal is just painted either side. I mean, if I'm submitting my proposal to a DRR donor, I would put my proposal as a DRR proposal and if I'm submitting the same to a climate change donor, I would whitewash it and call it a climate change proposal, while the activities remain the same".

Quoted from the ESPREssO Global Review (Amaratunga et al., 2017b)

4.3 Political will and motivation

A key barrier to the integration of DRR and CCA is low political will (UNISDR, 2012, Gero et al., 2011, UNISDR, 2010). Dupuis (2011) highlights that irrespective of developed or developing countries, low political interest to integrate will remain a key challenge. There is weak political recognition for DRR when compared to CCA (Venton and Trobe, 2008, Mitchell and van Aalst, 2008). In order to create an enabling environment to integrate DRR and CCA, political commitment should be increased by the high-level political authorities (UNISDR, 2010).

In most countries, the political will is greater towards socio-economic development rather. As a result of this, there is less motivation to integrate DRR and CCA. According to the ESPREssO Danish national review, in Denmark, there is an immense focus on economic development and reducing funding for emergency-related activities (Lauta et al., 2017). Similarly, ESPREssO global review discovers, in Asia, since many Asian countries are developing nations, politicians are more keen on socio- economic development (Amaratunga et al., 2017b).

The current policy set-up does not motivate political bodies to integrate DRR and CCA. Most of the legal frameworks and policies have a focus on immediate disaster response and recovery rather than for DRR or CCA or their integration. ESPREssO global review reveals that in Africa most DRR policies are set from a humanitarian angle and as a result, political bodies are motivated only for disaster response and recovery activities. The United States follows a similar approach, with political will greater towards humanitarian aid (Amaratunga et al., 2017b).

Further, general awareness at all governance levels on the integration of DRR and CCA is still not adequately dispersed. As a result of this, there is limited political and institutional awareness of the problem. According to the ESPREssO global review, in the African region, there is no right level of understanding or awareness within the political bodies on the integration of DRR and CCA. According to the analysis based on Asia, it specifies the lack of political will for the integration is an institutional issue. In many Asian countries, since DRR and CCA are under different institutions, politicians tend to consider matters only within their ministry (Amaratunga et al., 2017b).

In contrast, there is a much greater political will to integrate DRR and CCA in France, which is illustrated in the French National Adaptation Plan.

Political will in France

In France, there is a declared political will to converge DRR and CCA. DRR operators are asked to account for CCA in DRR projects and vice-versa (it is clear for DRR through the PAPI framework for example).

However, in some cases, existing legal/policy background may hamper the implementation of political will. This is the case in the context of:

- Non-binding regulations (e.g., land use planning regulation, where there is a requirement for best efforts), adaptation of climate change appears difficult to implement due to lack of methodologies and constraints.
- Mandatory regulations (e.g., coastal risk prevention plans), the methodology exists and is applied, and finally results in concrete incorporation of climate change scenarios in land use planning, whereby it is forbidden to build in some low-lying area to anticipate future sea-level rise and avoid maladaptation traps. Some regional actors (e.g. networks of municipalities in Aquitaine) say that this is not sufficient and that the coastal risk prevention plans should be strengthened on the topics of risk preparedness.

A law is currently examined by the parliament to modify land use regulations in coastal areas: the idea is to distinguish (1) area which are under the influence of today's shoreline change variability, and could be eroded within years of a few decades; (2) areas where temporary economic activities are possible on the medium term (a few decades), but which could be lost due to shoreline erosion and sea level rise then; (3) areas ruled by the current regulation.

Source- ESPREssO French national review (Susanne et al., 2017)

4.4 Stakeholder management

Stakeholder engagement and management is an important aspect for DRR, CCA, and the integration of DRR and CCA. In addition, stakeholder management is important to manage transboundary crisis and also to integrate science to the polices in DRR.

The effective integration of CCA with DRR requires the participation of a wide range of stakeholders: policy makers, private firms, scientists, NGOs, and educators (IPCC, 2012, UNISDR, 2009). Multi-stakeholders and multi-sectoral processes are vital in building common understanding, commitment and consensus (UNISDR, 2009). However, coordination of these different stakeholders with different interests is one of the challenges in integration due to an inability to reach consensus on specific adaptation measures (Lei and Wang, 2014). Decision makers are interested about scientific information on climate change to support decisions regarding adaptation (Mastrandrea et al., 2010). Most top-down approaches are used in climate impact assessment whereas bottom-up approaches are applicable in acquiring knowledge of vulnerabilities at the decision-making level. Developing an integrated approach to inform decision making has become a difficult task (Thomalla et al., 2006, Mastrandrea et al., 2010).

In regards to DRR and CCA positive point is the wide recognition of stakeholders in both DRR and CCA. Many countries in different regions of the world have identified their own stakeholders in relation to CCA and DRR within the existing legal and policy approaches. Accordingly, there are positive signs on stakeholder management. As revealed from the ESPREssO global review, in Asia, it is clearly demonstrated that after introducing the post 2015 agenda which is the SFDRR DRR and CCA communities are keen to sit together in global, regional and local events together having the intention of supporting the integration. Further, it was highlighted after the SFDRR DRR and CCA donors are interested to participate for DRR and CCA events, similarly, politicians are keen to attend for both DRR and CCA events (Amaratunga et al., 2017b).

Further, there are regional platforms which coordinate and manage the stakeholders within their regions. Asian Disaster Preparedness Centre (ADPC) is one of the examples from Asia. For nearly 30 years, Asian Disaster Preparedness Center (ADPC) has been contributing in making Asia-Pacific safer by strengthening disaster resilience at all levels.

The key challenge with stakeholder management is not the identification of stakeholders but, the allocation of tasks and responsibilities between the stakeholders. As the ESPREssO global review suggests, there are complex issues in allocating tasks and responsibilities among the stakeholders. For example, in Asian countries such as Pakistan, India, Bangladesh, there are difficulties in allocating responsibilities for the stakeholders at the state or sub-state level. Their roles and responsibilities are not allocated or clearly defined as there are no guidance or policy framework for stakeholder management at the state or sub-state level (Amaratunga et al., 2017b).

Similarly, ESPREssO global review highlighted, in Canada there are different stakeholders identified for DRR and CCA but, their roles and responsibilities are not defined. In Canada, a further limitation is that communities are not aware about the different stakeholders involved, their roles and responsibilities, and their role as a community representing the wider stakeholders (Amaratunga et al., 2017b).

Another specific issue which can be drawn from the Australian context derived from the ESPREssO global review is that CCA as a discipline does not have a wide recognition for stakeholder engagement. This is in contrast to DRR, which has a significant emphasis. In Australia CCA has this issue as there is lack of political will on the matters related to CCA. In the Australian context, there is less state level attention of CCA (Amaratunga et al., 2017b).

Another interesting issue which can be picked up from the African region is the duplication of stakeholder engagement due to the institutional split between DRR and CCA communities. As a result of this, stakeholders have to talk to two sets of institutions for DRR and CCA. This has complicated the stakeholder engagement and it does not address the issue of the overlaps and gaps between the two sets of actions (Amaratunga et al., 2017b).

These can be highlighted as key issues regarding stakeholder engagement in relation to DRR and CCA. In addition to these challenges there are some good French and UK examples on stakeholder engagement. These examples can be highlighted as good practices to integrate DRR and CCA communities as well as to integrate science into the policies. In the UK, some government institutions such as the Environment agency have the legal provisions to engage the stakeholders. In France, the French National Observatory for Natural Risks (ONRN) has listed the stakeholders and has demarcated their roles and responsibilities, and how each and every level is linked to each other. Figure 03 presents summary of stakeholder engagement in UK and figure 04 explains the summary based on stakeholder engagement in France.

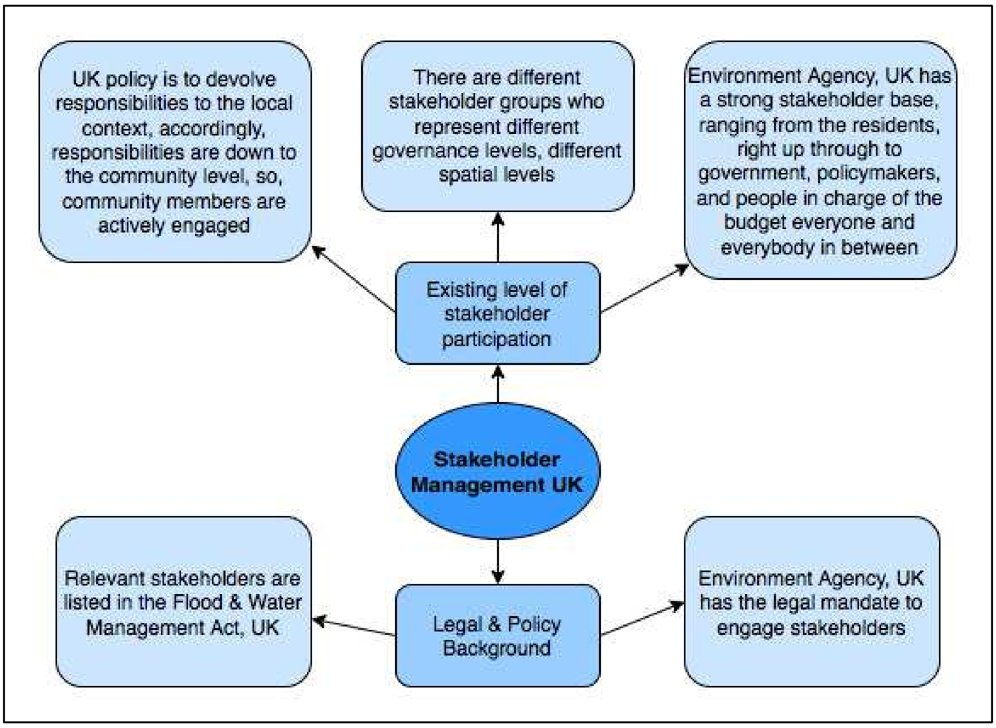

Figure 3- Stakeholder management, the UK
Source- ESPREssO the UK national review (Amaratunga, Haigh et al. 2017)

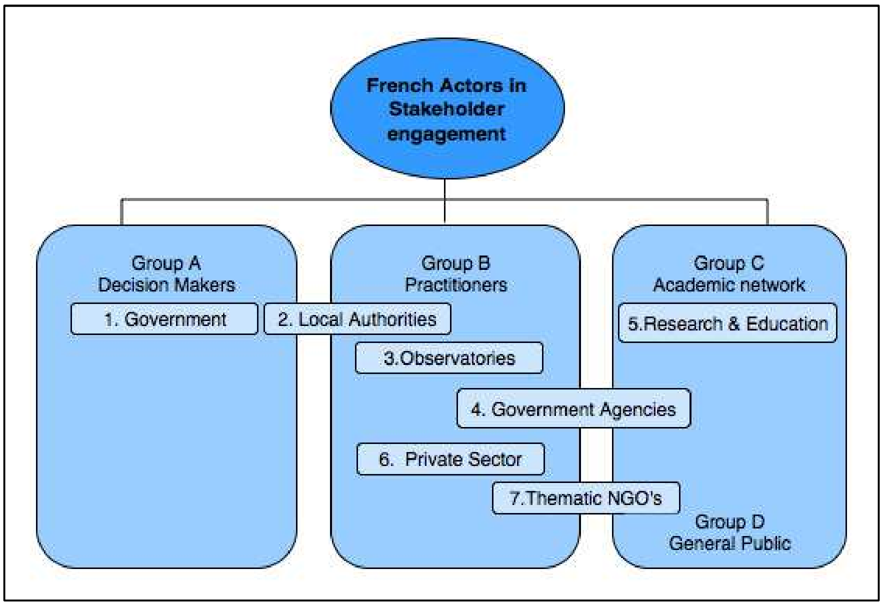

Figure 4- Stakeholder management, France
Source- ESPREssO French national review (Susanne, François et al. 2017)

4.5 Procedural Gaps and Legal Frameworks

Procedural gaps and legal frameworks is an issue to integrate DRR and CCA, enabling science for the policy as well as for transboundary crisis management. Most of the procedural gaps related to integration as well as for the science and policy are discussed or will be discussed under other issues. This section focuses on the procedural gaps and the legal frameworks related to transboundary crisis management.

Frequently disasters have cross-boundary impacts. Recent examples are the Aila Cyclone that affected India and Bangladesh in 2008, and the Kashmir earthquake in 2005 that affected both India and Pakistan. Recent European cases include the Central Europe flood, affecting Eastern Germany and Hungary, the extreme drought and heat wave that hit several countries in Europe in 2003 and caused the destruction of large areas by fires, and the earthquake that hit the borders between Italy and France in 1995. Experience shows that although there is a general tendency to cooperate, as the number of stakeholders increases so does the competition among them, while different regulations can hinder the organisation of an effective response.

The nature of the transboundary issues varies from the region to region and has specific issues related to its context.

In the EU, as disasters proliferate regionally and the focus shifts from post-disaster management to DRR, one of the big questions thus turns to how to utilise the most effective governance system. As the 'functional pressures for centralization and trans-nationalization exist alongside deep rooted and potentially conflicting political interests' (Bossong and Hegemann, 2015) , it is clear that striking the balance between transnational and localised policy processes is not fully developed yet within the EU. Within this debate there are however more nuanced arguments towards a blended approach. For example, the European Forum for DRR, in their outcomes statement from their March 2017 meeting, highlighted the importance of 'multi-level governance across vertical and horizontal boundaries to empower and build the capacities of local authorities, civil society actors and at-risk households' (EFDRR 2017). For example, since the early 1980s, flood policy in Spain has grown 'more complex' and is likely to evolve in the same direction during the following decades. Flood control works and post-disaster assistance, with accompanying wider trends have shifted towards warning and emergency actions, land use planning and insurance. However, their failure to synchronise with the EU's centralised policies, because of internal issues such as complex national land use law, reflects the future intricacies the EU will face when trying to implement transnational, multi-level legal frameworks across all Member States.

The EU efforts on DRR have increased vastly in the last 15 years. Nonetheless the framework, seen as a whole, face a number of challenges in balancing the very different needs and governance systems of member states, with an increasing need for a coherent and integrated DRR strategy for Europe. In particular, funding of disaster losses as well as DRR-efforts could play a key role in future efforts of the Union. Obviously, a number of highly political choices linger to these issues. As Boin and Rhinard suggest, leadership can be issue- this may pose a problem to the issue of "speak with one voice" (p.17). By addressing the leadership issue, the results may also impact the coordination challenge. Coordination between different member states and also within the EU to tackle transboundary issues is crucial.

For transboundary crisis and disasters, Africa has a continental body - African Union, which is an inter-Governmental organisation. There are different legal as well as policy documents which have been endorsed at inter-Governmental organisational level to ensure trans boundary management. The East African Community DRR and Management Act of 2013 is a very good example that inter-Governmental organisations have adopted, with acceptance by the member states of that inter-Governmental organisation, a document which focuses mostly on trans boundary crises as well as risk management. Similar policies also exist in Central and West Africa. The Southern African community has also recently adopted a preparedness strategy with all the member states of the Southern African Developmental Community in Southern Africa. However, the key challenge remains is the lack of capacity with the inter-Governmental organizations in Africa to influence their national counterparts.

Technical management and coordination issues are other key common challenges to manage the transboundary crisis. Accordingly, there is need to build-up common transboundary models and procedures to increase the effectiveness of a coordinated action in the field of the technical management of emergency, safety evaluation and risk prevention.

Further as revealed from the ESPREssO German national report, procedural and legal frameworks have substantially improved within the last 15 years, in particular in terms of flood warning, where clear regulations and agreements are in place in most of the regions. "Large scale, transboundary hydro-meteorological events like the Elbe/Labe floods in 2002 and 2013. Comparison of DRR and CCA capabilities in 2013 vs. 2002 demonstrates substantial progress that has been made on transboundary and transnational exchange of critical information and resources to deal with such disastrous situations". However, in terms of legislation, German law does not address the issue of international disaster assistance besides existing bilateral agreements. This does specifically apply to the case in which Germany itself would be in need for assistance from other countries (Mark et al., 2017).

Another key issue that was highlighted from the ESPREssO global review related to transboundary crisis management is that there are some nations who are much independent and not particularly willing to join with transboundary crisis management. Accordingly, at the state level there are no legal procedures to manage transboundary crisis. Two of the best examples are the United States and the United Kingdom (Amaratunga et al., 2017b). Figure 5 and figure 6 describe a summary on the transboundary crisis management from the UK and from the USA which are derived from the ESPREsso the UK national review and the ESPREssO global review.

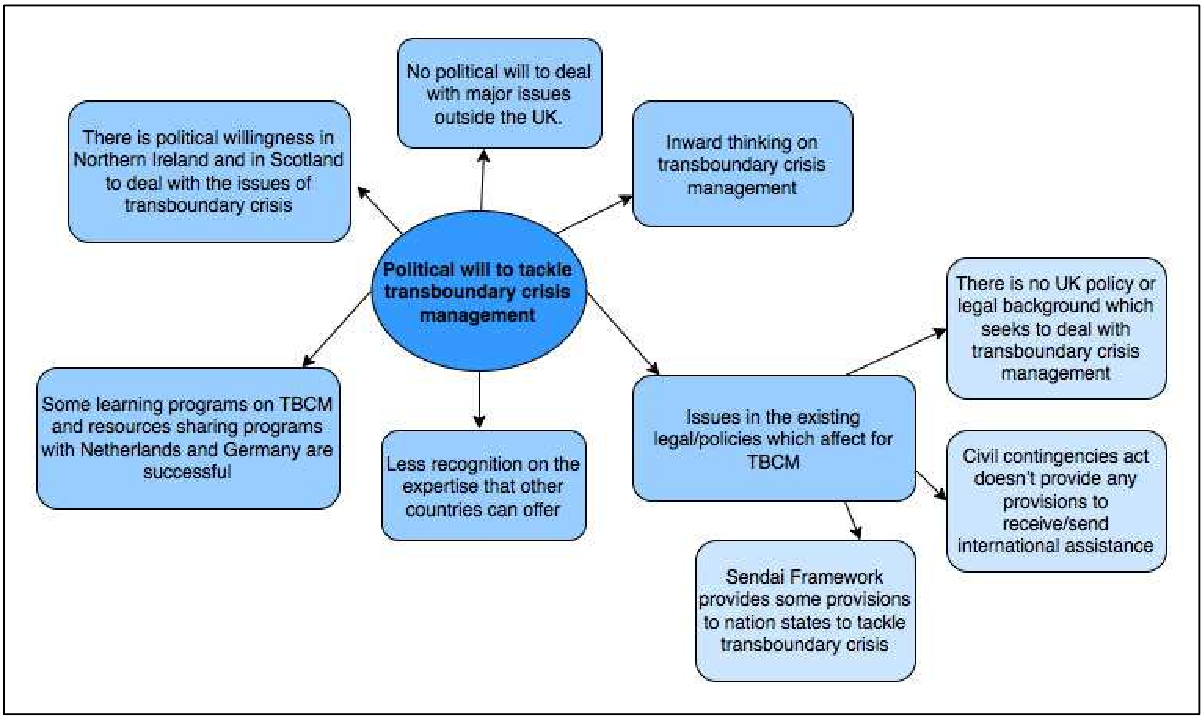

Figure 5- TBCM the UK
Source- ESPREssO the UK national review (Amaratunga, Haigh et al. 2017)

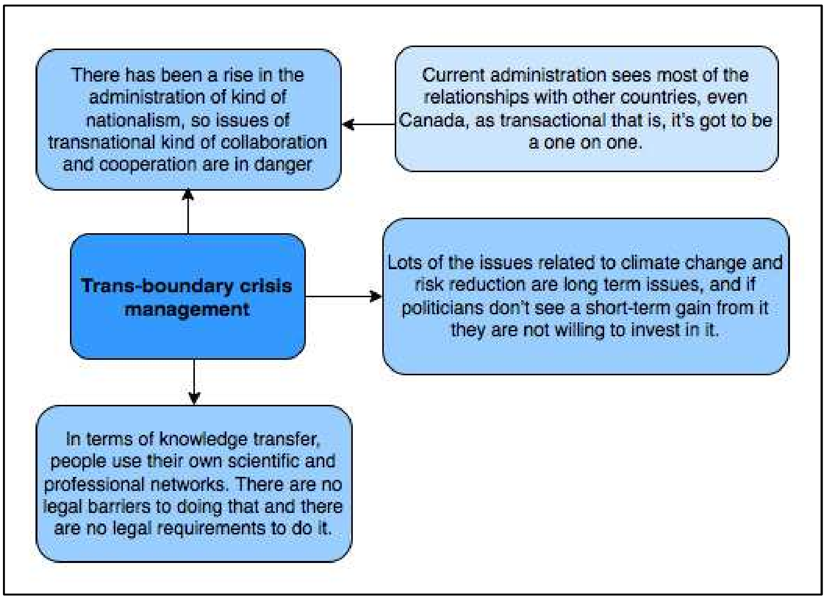

Figure 6-TBCM- USA
Source- ESPREssO Global Review (Amaratunga, Haigh et al. 2017)

4.6 Risk perception and risk assessment

4.6.1 Risk Perception

Having a common perception on risk is extremely important for the integration of DRR and CCA. It is important in supporting the transfer of scientific knowledge into the legal and policy agenda.

Climate risks are assessed by scientists (Parry, 2007), and hence the risk perception among public is different from that of scientists' view point (Slovic, 1987 cited in Taylor et al. (2014). Moreover, climate risk awareness among general public is limited due to many reasons (Kahan et al., 2012). For example, due to scientific illiteracy among the public (Pidgeon and Fischhoff, 2011), their bounded rationality nature which is either based on consciousness or heuristic views of climate risk (Kahneman, 2003) or cultural cognition (Kahan 2010 cited in in (Taylor et al., 2014). However, public perception about climate risk is an important element in disaster management as well as adaptation strategy, since they engage with the effects of climate change. However, little empirical evidences are available on climate risk perceptions on CCA when compared to climate change mitigation (Taylor et al., 2014).

As per the ESPRessO Swiss national review states,In Switzerland, there are conflicting reports about Swiss risk perception. Federal reports describe a growing awareness of readiness and personal responsibility among the public to mitigate effects from disasters, following well-channeled public advice (communicated via websites, well-defined evacuation routes etc). Yet, as ESPRessO Swiss national review highlights, in the case of individuals, members of the general public are increasingly unable to adapt as well as in the past (Booth et al., 2017). This is a common scenario in most countries. According to the ESPREssO Italian national review general public in most of the risk prone areas do not even know the risks their community is exposed to, and at which level (for instance, on volcanic and seismic risk perception in Italy (Zuccaro et al., 2017). In relation to the role of existing legal/policy frameworks in influencing the perception of risk among the communities, several studies from very different perspectives exist (e.g. Dolce and Di Bucci, 2014; Scolobig, 2015), especially in analysing the relation between risk perception, scientific/legal responsibility and public communication following the L'Aquila case. Similarly, according to the ESPREssO French national review, the risk perception of the general public in France, according to a survey in 2013 by polling firm IFOP, found that 78% of French people were unaware of what to do in the event that France's national alert system is triggered, and 63% didn't know the risks that their geographical location exposed them to (Susanne et al., 2017).

Another interesting reason which affects for the risk perception is the existence of climate change deniers. This is a worldwide issue, for example, as Herman (2017) states, climate scientist explains the need to battle against climate deniers. There is a perception that climate and weather is the same thing. This approach may be problematic, as the root of a certain event may not have been assessed.

Risk perception in Denmark

In a study conducted on perceptions on CC in Limfjord area in Denmark, it showed very high climate change awareness among mussel farmers (Ahsan and Brandt 2014). A study in Lolland in Denmark highligths that all respondents in that municipality not only agreed climate change is happening but also that it will not change the everyday lives of citizens there (Baron and Petersen 2015). The study also shows that only home-owners who have experienced flooding have taken measures to reduce the impact of floods on their homes proving that experiences shape actions (ibid). The study concludes, that "in spite of living in a designated flood risk area, flood risk does not seem to play any major role in the everyday lives of the homeowners of Lolland" (ibid: 1154). In a survey on CCA in Denmark, it was found that the majority of the municipalities identified and recognized that CCA is a crucial cross-cutting matter for policy and planning (Jensen et al. 2016).
Source- ESPREssO Danish National Review (Lauta et al., 2017)

Another overriding question in terms of risk perception, is clearly illustrated by the ESPREssO Swiss national review in the Swiss context. Within both the scientific and political community what is acceptable risk? (Wyss, 2016, FOEN, 2017). What assets are acceptable to sacrifice in order to ensure the existing system capacity is not overloaded. Can we cope with those times of overload? How can we prepare to mitigate as best as possible for when those inevitable times arrive? Finally, how can each event teach us something new, how do we learn from disasters and use each as a tool by which to strengthen system capacity making it a little more robust after each disaster. These are the key questions in regards to risk perception in between the political community and scientific community (Booth et al., 2017). Adding to this in the UK it was identified, some NGOs', some private sector, some government entities operate in the UK, lack risk experts. As a result, there is confusion over risk related concepts, e.g. What is the residual value? What is the control measure? What is mitigation? What is management?.

Further, ESPRessO Global review highlights a key perception issue between the DRR and CCA communities from the African context, in terms of the perception of risk, there are many differences between the two communities. The first is in terms of the kind of hazard that both communities talk about. The DRR community work on all kinds of hazards. The CCA community see themselves relevant only to climate related hazards.

For example, earthquake is a major hazard for many countries. The DRR community sees earthquake as a hazard, as part of risk, but for climate change community, it is not part of their agenda. Another reason for this perception issue between the two communities begin in terms of the origin of the two phenomena. The DRR community's origin is in humanitarian issues with the disasters which have already happened. The climate change community is largely embedded in scientific theories and scientific projections.

The DRR community talks largely about existing risks, for example, what we see as happening. The climate change community is more futuristic. What new risks might come up in the future based on long-term projections? While the risk community talks more about the short-term actions, which is never beyond five to ten years, the climate change community frequently addresses projections of 50 to 100 years.

However, as further revealed from the ESPREssO global review, current global policies address this issue in a positive way. For example, the SFDRR has brought these two perceptions together. The actions generated by the Hygo Framework for Action, which is the predecessor of the SFDRR, were focused on existing risk, the risk that we see. The SFDRR has introduced a term on new risks, or the prevention of new risks, which is much closer to futuristic projections of climate scientists.

4.6.2 **Risk Assessment**

A key issue in risk assessment is the standardisation of risk assessment and completing the risk assessment for all social economic infrastructure. As the ESPREssO French national review identifies, in France, risk evaluation at a national and regional level is based on natural hazard data and available information on vulnerability. Institutional engagement is strong. However, some aspects are still limited and incomplete. This is the case concerning national multi-risk assessment data: not all schools and hospitals have been evaluated in the sense of providing all the information necessary to integrate them into planning and development decisions. A list of schools potentially vulnerable to disasters is still not available. In regards to standardisation of the risk evaluation, at present, the evaluation follows user-defined standards. All data is made accessible via the ONRN platform. However, data is aggregated by region (*département*) and larger scale information (commune, municipality) is not disseminated (Susanne et al., 2017).

Also, institutional separation between DRR and CCA has hindered effective risk assessment. For example as stated in the ESPREssO the UK national review, in the United Kingdom, DRR and CCA are separated institutionally. As a consequence, for the same hazard, risk assessments are done by both DRR and CCA communities. This has created a duplication of work, reduced the efficiency of work and generated a competition between DRR and CCA actors (Amaratunga et al., 2017a).

As per the ESPREssO Italian nationl review, in Italy, in order to harmonise DRR and CCA, they should be integrated based on common risk assessment approaches. However, there is still an open debate on the different possible methodologies: hazards and risks vs. event and impact scenarios, probabilistic vs. deterministic approach, quantitative vs. qualitative description of the observed phenomenon. Moreover, the two communities have different technical jargon, and in some cases the same term has different meanings (Zuccaro et al., 2017).

In addition to the technical jargon there is a too technical emphasis on risk assessment. One of the common censure is that risk assessments do not have a people-centric approach. According to the ESPREssO Danish national review, it is highlighted that the Danish Meteorological Institute has been working towards better forecasting and to improve early warning systems. Some of the areas they have been working include storm surge modelling and remote sensing. These contribute to their work on emergency preparedness, but the criticism is that the approaches taken by many agencies have a more technical focus and there is need for a more people-centric approach (Lauta et al., 2017).

Access to data is one of the foremost challenge for successful risk assessment. This is a common problem in the globe as stated in the ESPREsSO global review, but, this was particularly highlighted from the study based on Asia. As we already discussed in the section 4.1, there are institutional barriers where DRR and CCA are operated by different government bodies. When there is a need for data to do a proper risk assessment these separated government bodies are not keen to issue data from their institutions. In fact, this is a problem of the whole governance system as these government institutions have very strict rules and regulations on releasing data to a second party. They are reluctant to go through with long and time consuming procedures to issue data for their own fellow organisations. As a result, most of the risk assessments are incomplete. Similarly, this is a critical challenge in the African region as well, due to this lack of information the projections are always poor in the African region (Amaratunga et al., 2017b).

Risk assessment in Africa

"In terms of risk assessment which is in terms of generating knowledge and also the technical aspects of the two sets of communities, the lack of detail, and I've seen more in terms of African perspective, the monitoring of disasters and the monitoring data has not been there for a historical period of time. If that is the case then we often tend to have less amounts of data for the kind of work we do, which results in poor projections and hence we can't actually implement our activities, because of lack of information that we have".

Quoted from the- ESPREsSO Global Review (Amaratunga, Haigh et al. 2017)

Community based information is also a very important set of information for successful risk assessment but in regions such as Asia and Africa, there is a lack of connection between the national level and the community level to obtain important information from the community level.

4.7 Scientific frameworks

As revealed from the study there are lots of scientific frameworks within the existing scientific approaches. These scientific approaches promote research and innovative programs. For examples, the Danish government clearly stipulates the need for research on CCA. The strategy mentions "The government will therefore launch initiatives to promote:

• development of modelling tools for socio-economic evaluation of measures in the CCA area to the extent they do not already exist; and

• establishment of a coordinating unit for research in CCA that will create better coordination and knowledge-sharing of CCA research in Denmark and in relation to the rest of the world" (Danish Government 2008:12).

In the United Kingdom, the Climate Change Risk Assessment (CCRA) has been identified as a system that uses scientific assessments to optimize CCA decisions (Porter et al., 2014, Tangney, 2016). The UK Government claims that their Risk Assessments are independent and impartial in policy making (Defra, 2012).

However, the issue is not the unavailability of scientific frameworks within the existing science approaches, but rather that the scientific frameworks are too focused on the natural sciences. A study on mapping climate research in Denmark in 2009 highlights that the majority of climate research (mitigation and adaptation) lies predominantly in the natural sciences (Ministry of Science, Technology and Innovation 2009). There is no data to show if that has changed as of today in Danish universities and research institutions. Similarly, in Germany, the role of social sciences is still underrepresented in CCA as well as DRR, favoring natural sciences as the leading research domain. Furthermore, there is an observable gap on the initiatives concerning social sciences from authorities and main funding institutions.

In addition, uneven popularity for DRR and CCA research is also another challenge. In Germany, climate change constitutes a more popular topic on research in comparison to disaster management. In contrast, in the United States and Australia, funding and support for CCA research has lessened due to declining political interest.

4.8 Communication

Communication is an important tool for the integration of DRR and CCA as well as to enable science into policies. Further, effective communication among nations is also key to manage transboundary crisis. This section considers communication gaps and issues in four different context:

- Communication between DRR and CCA communities
- Communication between academic community and practitioners
- Communication between practitioners and general public
- Communication with the adjoining nation states on trans-boundary crisis management

4.8.1 Communication between DRR and CCA communities

Proper communication between DRR and CCA communities is essential in order to integrate DRR and CCA as well as to bridge the gap between science and legal/policies. Typically, CCA develops scientific data whereas DRR produces data based on community perceptions. Scientific data generated from CCA should be transferred to the policy level via DRR to the community level. Consequently, it is important to have a proper communication channel between DRR and CCA.

Depsite this strong need, there are several problems to be overcome. CCA terminology tends to be more technical or scientific, which cannot or is more difficult to translate into simpler language. As a result, it is difficult to communicate to the community level. In a similar vein, the DRR and CCA communities tend to collect two sets of data. For example, the CCA community might collect weather data and consider how the data can be converted to identify potential flood risk, whereas the DRR community would look at the number of houses affected or at risk.

"Language plays a key role in generating awareness and action for DRR and CCA. Very interestingly, it was noted that resilience is not a common term used in the Danish language. Initially, when the resilience movement started, stakeholders were not very keen to take resilience on board. Now the concept of resilience is very much part of the Danish language on CCA"

Quoted from- the ESPREssO Danish National Review (Lauta et al., 2017)

Another obstacle for successful communication between DRR and CCA communities is the diverse spectrum of the respective communities. There are different types of people involved in DRR and CCA activities, some of them are not experts on either CCA or DRR. Consequently, they tend to define DRR and CCA concepts as per their knowledge spectrum. This has created diverse terminology for DRR and CCA. There is a need for a common language or standard definitions at the national levels. The issue is not with the availability of global terminologies, which have already been developed by organisations such as UNISDR, but that some nations are not adopting them.

"There are no clearly distinguished DRR and CCA communities, but, rather a very diverse spectrum of disciplines involved in both fields with accordingly different constructions of the problems. This complexity obviously involves misunderstandings and ambiguities"

Quoted from the ESPREssO German national review (Mark et al., 2017)

Another specific issue between DRR and CCA communication is, in some countries there is no link between DRR and CCA communities. This is due to issues such as institutional segregation and political negligence for CCA. There is a lack of information flow between the two communities. For example, as the ESPREssO global review informs, in Australia, DRR and CCA is totally separate, which hinders communication (Amaratunga et al., 2017b).

4.8.2 Communication between academic community and practitioners

Communication between the academic community and the practitioners was highlighted as a key point during the study. In many countries, communication between these two parties is fragmented, but there are some good examples.

A major concern is that a lot of academic research outputs are not transferred into practice. Good tools and techniques are developed from academic research, but, there is no proper platform to transfer that knowledge to practice.

For an example, the global analysis found that in Asia, in most cases, new tools and techniques for DRR and CCA are tried and evaluated only for academic research. It is not transferred into practice. As a result, when practitioners need to address issues, they have to follow same old tools and techniques. Similarly, academic research is often done only as pilot projects. Even when projects are carried out in collaboration with practitioners as pilot projects, the results are not often replicated as a part of a process. For example, pilot projects implemented in one part of Thailand were not replicated with other other areas of the country.

The global review found that most practitioners in the African region just follow global documents without making any reference to the academic publications. Therefore, they are not up to date with the current trends and developing issues. On the other hand, academic work often ends up as a journal publication, which is not easily accessible to practitioners.

There are also some good examples of communication between the academic community and practitioners. Many UK universities have collaborations with national level organisations who deal with DRR and CCA. Further, there are non-government institutions who are active in DRR and sponsor PhD students in order to keep the link and proper communication between these two parties. In addition, the Environment Agency, which is a government level institution, has a strong link and collaborations with many leading universities in the UK. While there is no legal/policy mandate which specifies or directs the communication between the academic community and the practitioners, but despite this, it is already there in a positive way.

4.8.3 Communication between practitioners and general public

Communication between practitioners and the general public is important in order to bridge the gap between science and legal/policies. Generally, once new knowledge is generated through science it should be disseminated to practice, and via practitioners that knowledge should be transferred to the general public.

A lack of awareness among the general public on general concepts of DRR and CCA is a key barrier that prevents risk and vulnerability being effectively communicated. There can be other barriers as well. According to the ESPREssO global review, in Thailand there is no specific word for DRR, so communicating this concept is even more challenging (Amaratunga et al., 2017b). Public interest is also a concern. While government organisations often have programs to communicate to the community regarding risk and vulnerability, people often do not engage as they have the perception that a disaster will not happen to them.

> "People think a disaster may not ever happen to them. They are very keen when a disaster happen somewhere in the country, but, refuse to understand that all communities have a risk of a potential disaster. So, until it happens they do not want to be updated about the disaster risks and its consequences".
>
> Quoted from- ESPREssO the UK national review (Amaratunga, Haigh et al. 2017)

Information flow is another key challenge. In most countries, there are state level mechanisms to communicate with the general public, but, when it comes to the local or community level, the information is not transferred properly. One of the major reason is for this is the language barrier. Reporting of false information is also an increasing problem. For example, like many countries, people in the UK are highly active on social networks, but there are many instances of 'false news' which has led people to question the reliability of information even if it is released by reputable agencies (Amaratunga, Haigh et al. 2017).

As the ESPRessO global review discovers, in Africa, there is a huge gap that prevents transferring of practitioners' knowledge to the general public. The public has a lack of awareness on what DRR and CCA practitioners do and are not ready to accept what they have been informed (Amaratunga et al., 2017b).

Further, the ESPREssO global noted that especially in Asia the mode of communication is limited mostly to a single method. This means, in most of the Asian countries, there are no specific guidelines to address special needs of communities. such as communicating information to blind and deaf people, or information sharing with the people who are illiterate (Amaratunga et al., 2017b).

Also, it was discovered that 'sharing of additional information' to the communities is really important for successful communication. One of the common issue in the Asia is that people are given only general or generic information, but not the specific or additional information that might make it relevant to the local context. For example, in flood prone areas people are informed that there is a flood risk, but information such as an evacuation strategy is not provided. People are not interested in general information (Amaratunga et al., 2017b).

There are however some good examples. In the UK, the environment agency, one of the main bodies in the UK for disaster management, has done a lot of work to communicate data to the general public. They have made efforts to disseminate specific data on disaster risks online, where people can easily access it. In addition, Environment Agency holds different types of workshops, programs to disseminate their findings to the general public. Further, most of the government institutions in the UK are very positive on communication information to the general public. For example Met office, British geological survey department, environment agency, they always seek to improve ways for public communication (Amaratunga et al., 2017b)..

4.8.3.1 *Communication with the adjoining nation states on trans-boundary crisis management*

Some nations are more independent and not keen on transboundary issues. This is a key challenge for communication. Countries such as the USA is more independent and there is low political will to deal with transboundary issues. As a result, there are no proper communication channels with neighbouring nations.

Language barrier is particular a challenge working with nation states for cross border crisis management. The French Red Cross cites in its annual report the feedback of a number of border SDIS (who are accustomed to working with foreign relief teams), to have raised the problem posed by language. This problem can be resolved more easily at the cross-border level as we shall see further on. In practice, in the field where the international relief team mission leader is the only person to receive instructions makes communication is relatively easy. However, one or more interpreters have to be found quickly, depending on the number of relief teams arriving in the country in the event of a disaster. This would appear to be the ideal solution when neighbouring relief teams undertake, alone, missions in a given area. However, this solution seems to cause problems when border teams cooperate in the same area, while the language problem is heightened when different working methods and techniques are applied.

Besides the language barrier, another communication difficulty arises when there is no established, high-status organization that can act as a hub for information collection and dissemination. Response organizations often develop dedicated systems of communication, specialized for their purposes. These dedicated systems typically produce communication incompatibilities across response organizations (9/11 Commission, 2002; Snook, 2000). In addition, information is likely to flow most easily between jurisdictions and between organizations that have had frequent or routine contact as a result of previous events. Prior interaction is likely to create channels of both informal and formal communication (Kapucu, 2006). Yet transboundary crises bring together jurisdictions and organizations that have not been frequent collaborators.

5 Conclusions and way forward

The aim of this report was to review the existing legal, policy and science approaches with particular focus on six national perspectives in Europe (Italy, Germany, France, Switzerland, The United Kingdom and Denmark), an EU-wide perspective, and a global perspective.

Accordingly, section 3 of the report provided a general review on the key legal/policy and science approaches exists globally, within the European commission and within in the six national contexts. Thereafter, section 4 of the report analysed the key issues and the challenges of the existing legal/policy and science approaches and the consequences of the current context.

5.1 International Policies

2015 was a landmark year as three important global polices were introduced in 2015, namely the SFDRR, Paris agreement and the SDGs. The post 2015 SFDRR can be identified as a way forward in DRR and CCA as for the first time in the global DRR polices climate change is considered as one of the drivers for DRR. Accordingly, SFDRR recognizes the importance of respecting the mandate of the United Nations Framework Convention on Climate Change. In addition to that SFDRR also recognises that effective DRR contributes to sustainable development. While recognizing the fact that disasters undermine the efforts to achieve sustainable development.

Further, sustainable development agenda, which was adopted on 25th September 2015, consist of set of goals to end poverty, protect the planet and ensure prosperity for all. These goals are to be reached within the next 15 years and the goal number 11 has specific focus on DRR. SDG's have tried to create some coherence between sustainable development agenda and SFDRR. Similarly, there is a specific goal for climate action, which aim to combat climate change and its impacts. It recognize the Paris Agreement and that all countries agreed to work to limit global temperature rise to well below 2 degrees Celsius, and given the grave risks, to strive for 1.5 degrees Celsius.

Accordingly, it can be noted, that these global policy frameworks have created a significant opportunity to build coherence across overlapping policy areas, Further, it is believed that these global agreements will provide a foundation for a shared aim of making development, sustainable, resilient and safe cities. However, as highlighted from the study, the challenge is the implementation and monitoring. Further, there are criticisms on these global policies claiming that they are not genuinely seeking to integrate DRR and CCA (see section 3.1.4). But, as a whole it can be noted that these posts 2015 polices have shown some positive signs to address the current challenges of integration of DRR and CCA, transboundary crisis management and the legal vs policy issue.

5.2 EU Policies and Legal Frameworks

There are number of European organisations engage in DRR and CAA. These include, DG ECHO, the EU's department for aid and emergency relief assistance; DG CLIMA, the Directorate-General for climate action; DG Clima, the main body of the European Commission for climate change and climate policy; DG ENV, the main body in the European Commission for environment policy and implementation; DG DEVCO, the Directorate-General for international cooperation and development; EEA, an independent agency of the EU that provides information on the environment; and ICCG, a European research institution focused on climate change mitigation and adaptation.

In addition, there are a number of legal and policy frameworks in the context of DRR and CCA within Europe. It has been very difficult to segregate the two. One policy on DRR may have impacts for CCA and vice-versa. Further, frameworks and policies have far reaching effects on DRR and CCA for not only member states but also across their boundaries. Most of these frameworks and policies cross over different thematic areas of DRR and CCA along with national boundaries.

In recent years, the Union has developed into an apt crisis manager with a number of activations of the Civil Protection Mechanism, and other crises related mechanisms (also in relation to climate related events). However, the Union still struggles in balancing national agendas with the need for further regional coordination in integrating DRR and CCA strategies into the heart of EU-policies.

Here the asymmetries in capacities, infrastructure, natural landscapes and governance systems across the European region poses a particular challenge, that speaks to develop approaches that also allows for substantial national and regional differences in the implementation. Simultaneously the urgency of the issue calls for further integration of both DRR and CCA considerations across relevant EU policies. The Union has accepted this challenge and in recent years invested, both organisationally and economically in CCA and DRR. Nonetheless, a number of central challenges persist. These are visible in governance structures; struggles at the local municipality levels to attract funding for DRR or CCA; the institutional barriers to integrate CCA and DRR. These challenges are further coupled with the lack of or low political will that is absolutely essential to the issues at hand.

5.3 National- Legal Policy and Science Approaches

According to the six national reviews it is noted that all countries have a strong legal/policy background for Disaster Response and recovery rather than for actual DRR or CCA. For an example in Italy there is Law number 996/1970 for civil protection interventions. This law considered the emergency phase and outlined an embryonic system of civil protection. Similar, in the UK, Civil Contingencies act acts as the coherent framework for disaster management, however, the key focus is on disaster response and recovery. Therefore, it is noted that the government bodies are more keen on emergency disaster management than DRR or CCA.

However, there are varies legal/policy approaches available in these countries focusing particular disasters. For example, German Flood Protection Act, 2005 which is a shift towards a more integrated flood-risk-management system in Germany that also considers non-structural measures to minimize adverse effects of flooding. Similarly, the UK has Flood and Water Management Act, 2010 which is a legislatory step towards improving both food risk management and the way to manage water resources in the United Kingdom It seeks to define clearer roles, responsibilities and standards for the creation of sustainable drainage.

Within the last 10 years, these countries have developed national adaptation plans/strategies for climate change which is a positive way forward. There is Danish Portal for Climate Change as a part of the CCA Strategy 2008. France has the National strategy on CCA, 2013, which was completed by a National plan on CCA for 2011-2015.

In addition, all of these countries have particular science approaches in relation to DRR and CCA, for example the Italian National Institute for Environmental Protection and Research (ISPRA), United Kingdom Climate Impact Programme (UKCIP) etc.

As a whole it can be noted that there are legal/policy and science approaches for DRR and CCA, but, the issue is that these legal/policy and science approaches are focused only on either CCA or DRR, but, not to see them as integrated disciplines.

5.4 Key Issues in the existing legal/policy and science approaches

There are several issues in the existing legal/policy and science approaches which have created institutional barriers, uneven funding arrangement, a lack of political will and motivation, and complex stakeholder management.

DRR and CCA policies are fragmented, with separate institutions for DRR and CCA, and who operate in an isolated manner. As a result of this there is no proper communication between these organisations and mainly there is a competition between these institutions rather than working in a collaborative manger. Therefore, institutional barriers have become a hurdle for successful integration. However, it was clearly demonstrated from the national input reports as well as from the global report that the post 2015 agenda which is the SFDRR has a key focus on development oriented DRR and CCA. This means integrating DRR and CCA together and then integrate it to the development agendas of countries. This is considered as a way forward for sustainable development.

Funding is a common barrier to the integration of CCA with DRR. As revealed from the study most of the countries do not have a specific legal or policy background for the allocation of funding for DRR and CCA. There are different funding coming from different funding sources but not equally allocated for DRR and CCA.

Funding allocation is determined by the existing institutional structures. At the moment, the existing institutional structures and legal frameworks are diverse and therefore, funding are within different groups.

In most of the countries, despite the fact the country is a developing nation or a developed nation, the political will or the motivation is towards the socio-economic development rather than for DRR or CCA. As a result of this, there is a less motivation to integrate DRR and CCA. On the other hand, current policy set-up does not motivate political bodies to integrate DRR and CCA. Most of the legal and policies have the focus on immediate disaster response and recovery rather than for DRR or CCA or the integration.

In regards to DRR and CCA positive point is the wide recognition of stakeholders in both DRR and CCA. Many countries in different regions of the world have identified their own stakeholders within the existing legal and policy approaches and accordingly, there are positive signs on effective stakeholder management. The key issue with the stakeholder management is not the identification of stakeholders but, the allocation of tasks and responsibilities between the stakeholders.

Procedural gaps and legal frameworks are mostly to deal with the transboundary crisis management. Lack of capacity with the inter-governmental organisations is a challenge for transboundary crisis management. Technical management, coordination issues are other key common challenges to manage the transboundary crisis. Further, it was highlighted some nations are not willing to join for transboundary crisis management as they want to be more independent nations.

Different risk perceptions and risk assessments are a key obstacle for successful integration of CCA and DR and most importantly to transfer scientific knowledge into the policy. Institutional segregation is the key reason for this. Since, there are different institutions who work in isolation, it is hard to access for data of proper risk assessment. Similarly, as a result of this institutional segregation, different DRR and CCA actors perceive DRR and CCA terminologies in different ways. Accordingly, there is a need for common terminologies or a catalogue for DRR and CCA concepts.

Communication is a key for successful integration, to bridge the gap between science and policy and as well as for transboundary crisis management. Currently, the CCA terminology is fairly separate. It's more technical or scientific which cannot be translated into simple language. Further, another obstacle for successful communication between DRR and CCA communities is the diverse spectrum of DRR and CCA communities. Further, academic outputs are not communicated to the practice and the practitioners are not keen on it. In terms of communicating to the general public, there is a need to enhance the enthusiasm of people on the concepts such as risk and vulnerability as people are not interested to pay their attention on these issues until a disaster hits them. Transboundary communication should be enhanced by establishing, high-status organization that can act as a hub for information collection and dissemination.

5.5 **Way Froward**

This study analysed the key issues and the challenges of the existing legal/policy and science approaches and the consequences of the current context. Accordingly, in order to overcome these issues, the current legal/policy and scientific backgrounds should be altered according to the needs. The next phase of this study which is known as task 2.2 in the ESPREssO project, there will be a detailed review to find how to overcome these issues by enhancing the current legal/policy and scientific backgrounds.

6 List of Input Reports

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8 Annextures

Annexture 01

ESPREssO
Enhancing Synergies for disaster PRevention in the EurOpean Union

Synthesis report of legal, policy and science approaches within the frame of disaster risk reduction and CCA

National Report - ITALY

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 700342.This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein

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1 Introduction

1.1 Brief geographical profile

Italy is a land with a very diverse, extremely complex and jagged geography. Its position, in the middle of the Mediterranean Sea, has influenced the political and economic development of the country along its history.
Its political boundaries, for the greater part, correspond to its natural boundaries: the Alps in the North side, (neighbouring France, Switzerland, Austria and Slovenia), and the three seas – Adriatic, Ionic, Tyrrhenian – in the East, South and West side. Two great islands, Sicily and Sardinia, are integral part of the Italian nation.
The total area of the nation is about 300.000 km², embracing 60.000.000 inhabitants, 8.094 municipalities, 110 provinces and 20 regions. Its maxim longitudinal extension is 1200 km (from the White Mount to Lampedusa Island) and its coastline is 7.375 km long.

Figure 7 Regions, Geographic Distribution and Population per Km²(ISTAT 2015)

Thanks to its longitudinal extension of and the mostly mountainous internal conformation, the climate of Italy is highly diverse. According to the Köppen climate classification the northern and central regions have humid subtropical and humid continental and oceanic climate, otherwise the coastal areas, especially Liguria, Tuscany and the South Mediterranean Regions fits the Mediterranean Climate Stereotype.

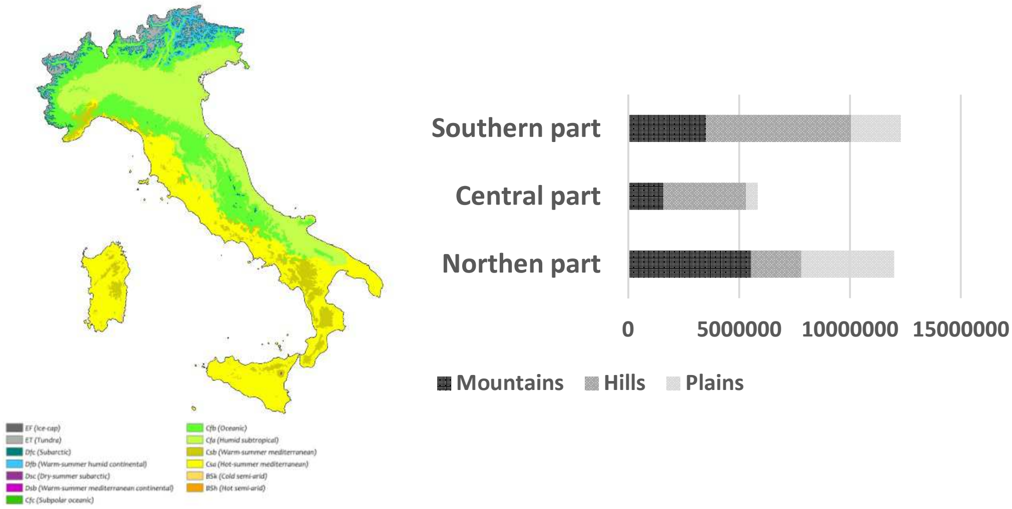


Figure 8 Köppen climate classification and distribution of mountains, hills and plains in Italy (ISTAT 2008)

Following diverse past geological and environmental events, Italian land has a fragmented and divided nature. There are two main mountain ranges, the Alps and the Apennines, giving a strong mountainous nature to the inland. Lowlands only cover the 23,2% of the whole territory, instead the 41,6% consists in hills – especially in the central regions – and the 35,2 % consists in mountains. In particular, the Apennine Ridge along the central part of Italy, contributed significantly to the division of land and its populations.

Italy is also a volcanically active country, containing the only active volcanoes in mainland Europe. Three main clusters of volcanism exist: a line of volcanic centres running northwest along the central part of the Italian mainland (Campanian volcanic arc – Vesuvius, Campi Flegrei and Ischia); a cluster in the northeast of Sicily (Etna, Stromboli and Vulcano); and another cluster around the Mediterranean island of Pantelleria.
Since the origins, the deep anthropization, the population density and the level of urbanization affect the environmental balance of such a fragile land. Dates back to 1922 the establishment of the first national park, the Gran Paradise Park, and currently 24 national parks together with other protected lands – at regional and municipal level – cover the 6% of the whole national territory. In addition to protected lands and parks, there are numerous marine protected areas of international relevance, due to the presence of unique flora and sea fauna.

Regarding the market economy conditions, Italy is one of the world's most industrialized and highly developed nation and is part of the European market and member of the Eurozone. The GINI coefficient is 34. Despite important achievements, the country's economy today suffers from structural and non-structural problems: after strong GDP growth in 1945–1990 high tax rates and excessive regulation caused the country to a stagnation in the economy growth between 2000 and 2008. Italy is targeting a public budget deficit of 2.8% in 2015, remaining inside the European Union’s 3% cap. The gap between North-South is now a major factor of socio-economic weakness: even at present, huge regional disparities persist.

1.2 Country risk exposure

The geomorphological and climatological characteristics of Italy and, not lastly, the young establishment of the Country (1861), have a great influence on the exposure and vulnerability of the territory to natural hazards.

1.2.1 Seismic Risk

Located between two tectonic plates – Euro Asiatic and African plate – Italy is characterized by a high seismic risk and the most affected nation in Europe. Strictly connected to the geological asset of the territory are the seismic events interesting the whole national territory, with variable intensity except Sardinia, the West Po Valley, part of the Alps (expect the West Alps) and Puglia. The Apennine ridge is where the greater seismic risk exists, and the whole risk covers the 80% of the entire Italian territory. The highest level of seismicity activity is located in the

region of Friuli and along the South-Central Apennine, from Umbria until Lucania and from South Calabria until Sicily.
Below are some data concerning the entity of the seismic risk in Italy:

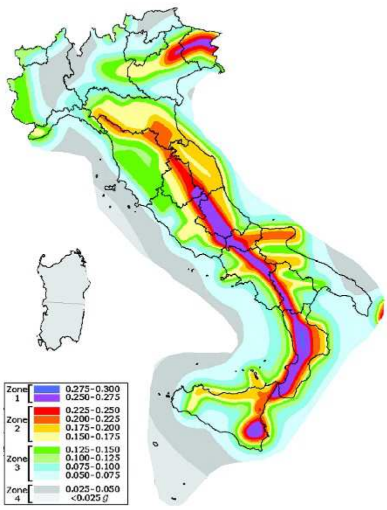
- High seismicity area is about 28.026 km²;
- More than 30.000 seismic events from 1000 AD until today and 200 events were disastrous events;
- More than 120.000 victims in the last century;
- About 100 billion of euro of damages in the last thirty years;

Major seismic events in the last fifteen years are (also see figure 7):

- Earthquake of central Italy (Regions of Umbria and Marche) in 1997 with 11 victims;
- Earthquake of San Giuliano (Molise) in 2002 with 30 victims;
- Earthquake of L'Aquila (Marche) in 2009 with 309 victims;
- Earthquake in the region of Emilia Romagna in 2012 with 17 victims;
- Earthquake of the Central Italy in 2016-2017 with 311 victims;

These data show how disaster events are happening constantly with a corresponding increase in the loss of human life. Human life loss depends, most of all, on two conditions: a significant growth of urban areas in highly seismic regions and the significant vulnerability of buildings, due to the presence of a large number of heritage buildings, the high number of buildings and infrastructures built before the first national seismic regulation (1971).

Starting from 2003 was implemented a seismic classification of the whole national territory and ensuring, at the same time, a better and increasing law implementation in the field of mitigation and prevention of the risk (Prime Minister Order n. 3274 of 2003).



DATE	AREA	MAGNITUDE	DEATHS
17/07/2001	Alto Adige	5,2 ML	4
31/10/2002	San Giuliano di Puglia, Molise	5,8 Mw	30
14/09/2003	Bologna, Emilia-Romagna	5,0 ML	–
24/11/2004	Salò, Lombardia	5,2 ML	–
26/10/2006	Stromboli, Sicilia	5,8 Mw	–
23/12/2008	Parma, Emilia-Romagna	4,9 Mw	–
06/04/2009	L'Aquila, Abruzzo	6,1 Mw	309
03/11/2010	Napoli, Mar Tirreno	5,4 ML	–
20/05/2012	Finale Emilia, Emilia-Romagna	5,8 Mw	7
29/05/2012	Medolla, Emilia-Romagna	5,6 Mw	20
26/10/2012	Mormanno, Calabria	5,2 Mw	1
21/06/2013	Carrara, Toscana	5,1 Mw	–
29/12/2013	San Gregorio Matese, Campania	5,0 Mw	1
05/04/2014	Capo Rizzuto, Calabria	4,7 Mw	–
24/08/2016	Accumoli, Lazio	6,0 Mw e 5,4 Mw (Norcia)	299
26/10/2016	Castelsantangelo sul Nera e Visso, Marche	5,4 e 5,9 Mw	1
28/10/2016	Mar Tirreno	5,8 ML	–
30/10/2016	Norcia, Umbria	6,5 Mw	2
18/01/2017	Capitignano, Abruzzo	5,1 Mw, 5,5 Mw e 5,4 Mw	9

Figure 9 Seismic classification (INGV) and Mayor seismic events (CPD)

1.2.2 **Volcanic Risk**

For what concerns volcanic hazard, the variety of volcano's typologies and the characteristics of the surrounding context pose diverse risk conditions, mainly in Campania and Sicily regions, but with potential effects all over Italy and Europe in case of large eruptions. The Italian volcanoes classification by the international scientific community is based on the state of activity, falling into three categories; extinct volcanoes, quiescent and active. Extinct volcanoes, whose eruption dates back to 10.000 years ago, are volcanoes Amiata, Vulsini, Cimini, Vico, Sabatini, Pontine islands, Roccamonfina e Vulture. Quiescent volcanoes, registering seismic and chemical activity and thus characterised by different levels of eruptive potential, are Colli Albani, Campi Flegrei, Ischia, Vesuvius, Salina, Lipari, Vulcano, Isola Ferdinandea and Pantelleria. Vesuvius, Campi Flegrei and Vulcano have a very low eruptive frequency and are in situation of obstructed conduit. Not all the quiescent volcanoes present the same risk level, both for its eruptive entity and for the population involved in the area of the eruption. Even more worryingly is the case of Campi Flegrei and Vesuvius characterized by explosive activity. Vesuvius and Campi Flegrei are placed in one of the most densely populated areas of the country and for this reason among the most dangerous, monitored and studied volcanoes worldwide.

Active volcanoes with a continuous eruptive activity in the last years, such as Etna and Stromboli, present manageable risk conditions in the short term, with potential periodic consequences in case of major eruptions e.g. on local air transport (Etna) or tourism activities (Stromboli). The volcanic activity in Italy is also concentrated in submarine areas of Tyrrhenian Sea and Sicily Canal, like Marsili, Vavilov, Magnaghi, Palinuro, Glauco, Eolo, Sisifo, Enarete volcanoes, some of them characterized by a recent history in terms of monitoring and studies and thus entailing diverse potential risk conditions.

Figure 10 Volcanic areas (in red) and aerial view of the Vesuvius, Ischia and Campi Flegrei system

1.2.3 Hydrogeological Risk

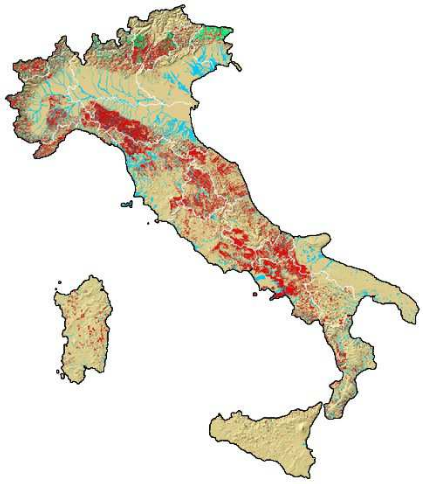
The hydrogeological risk in Italy represent the greatest source of physical, economic and social impact. The national area classified with high level of hydrogeological risk cover 47.747 km² (15,8% of the total Italian area), divide in landslides area (23.929 km²) and flood area (24.411 km²).

The municipalities affected by high landslide hazard P3 and very high hazard P4 (PAI) and/or medium hydraulic hazard P2 (Decree 49/2010) are 7.145, resulting in 88.3% of Italian municipalities. The prevalence of mountain and hills areas, consisting in soft rocks or heterogeneous rocks, in addition to the high level and concentration of rains and the lack of tree cover, makes the Italian territory particular exposed to hydrogeological risk. Especially the pre-alpine area, the North Apennine, the Adriatic pre-Apennine area, the Apennines of Calabria and Lucania, are particularly subject to massive phenomena of drought. In relation the amount of rainfall, floods are increasing in areas where waterways have a low gradient. Flood risk affects especially Northern Italy plain after heavy autumn rains or after spring rains in addition to water from melting snow and ice, and in the Southern part of the country, because of storms or other extreme water events. In the last 80 years 5.400 flooding and 11.000 landslides have happened and in the last 20 years this event have regarded a population on 70.000 persons with a damage of 30.000 billion of euro. The most severe event of this kind was the flood in Sarno in 1998 after which the Minister of the Environment and the other subjects involved, have started a pilot investigation on the hydrogeological risk condition of the whole territory aiming at preventing and monitoring the risks.

In addition to environmental aspects of climate and land, human action has contributed, over time, to the increasing of this risk exposure, due to the subtraction of ground from the fluvial beds, the urbanization of alluvial sites, deforestation, the lack of maintenance work of riverbanks, drainage canals, ditches and all the interventions essential for the safeguard of the territory itself.

Climate change projections, which envisage in Italy different patterns of precipitations distributions in the different seasons in the mid to long term, although with a decrease in the average rainfall show at the country level a general expected increase in the number of "extreme precipitation events", aggravating the likelihood of hydrogeological events in the future.

REGIONS	MUNUCIPALITIES AT RISK	%
Calabria		100%



Trento (Province of)	222	100%
Molise	136	100%
Basilicata	131	100%
Umbria	92	100%
Valle d'Aosta	72	100%
Marche	239	100%
Liguria	232	99%
Lazio	372	98%
Toscana	280	98%
Piemonte	1049	87%
Abruzzo	294	96%
Emilia Romagna	313	95%
Campania	504	92%
Sardegna	201	92%
Friuli Venezia Giulia	306	81%
Sicilia	200	78%
Lombardia	277	71%
Bolzano (Province of)	46	60%
Veneto	327	59%
TOTAL	**6633**	**82%**

Figure 11 Hydrogeological risk map (RED: landslides, BLU: flood, GREEN: avalanches) and Municipalities with hydrogeological risk

1.2.4 Environmental and Industrial risk

Air and water pollution constitute a severe problem in Italy, with aggravating factors related to the anthropization and industrial uses of the territory. Air pollution affects especially big cities, in particular the ones of the Po Valley, where exchanging among air masses are slower and where, in winter, the phenomena of temperature inversion occurs. In this area, the level of air pollution continues to be high even outside the great metropolitan areas, especially along the most important infrastructure. Extensive traffic in the largest metropolitan areas continues to cause severe environmental and health issues, even if smog levels have decreased.

Water pollution is another aspect linked to the human action and, in the Italian territory, interests the majority of rivers and coasts. In fact, the Government has established a complete regulation on industrial waste only after the disaster event of Seveso, occurred in 1976 in a small chemical manufacturing plant in the city of Seveso, North Italy, known for the highest exposure to dioxin of residential population in the country. This event gave rise to international attention and led to industrial safety regulations known as the EU Seveso II Directive. After the Chernobyl disaster, the nation terminated its nuclear programme, launched between 1963 and 1990. Despite the closure of nuclear power plants in Italy, the attention on nuclear risk remains high, especially for the presence of nuclear plants in foreign territory, less than 200 km from the national border. In this range, there are currently thirteen active nuclear power plants in France, Switzerland, Germany and Slovenia.

The national plan for radiological emergencies, approved by Decree of the President of the Council of 19 March 2010, identifies and regulates the measures necessary to deal with incidents that may occur in nuclear power plants outside the national territory, requiring a coordinated intervention at national level.

Regarding mining and oil extraction on the national territory, the extraction process has started in the late XIX century after fossil discoveries in the regions of Basilicata and Calabria. In Basilicata, in the Agri Valley, is present the biggest Europe Continental oil extraction site and on the whole territory are located about 10 gas storage fields.

The possibility of both natural and industrial disasters, defined in literature as “Na-Tech” (Natural – Technological), can produce toxic substances spills, fires or explosions, in highly populated and industrialised areas, resulting in more risk situations for the urban community.

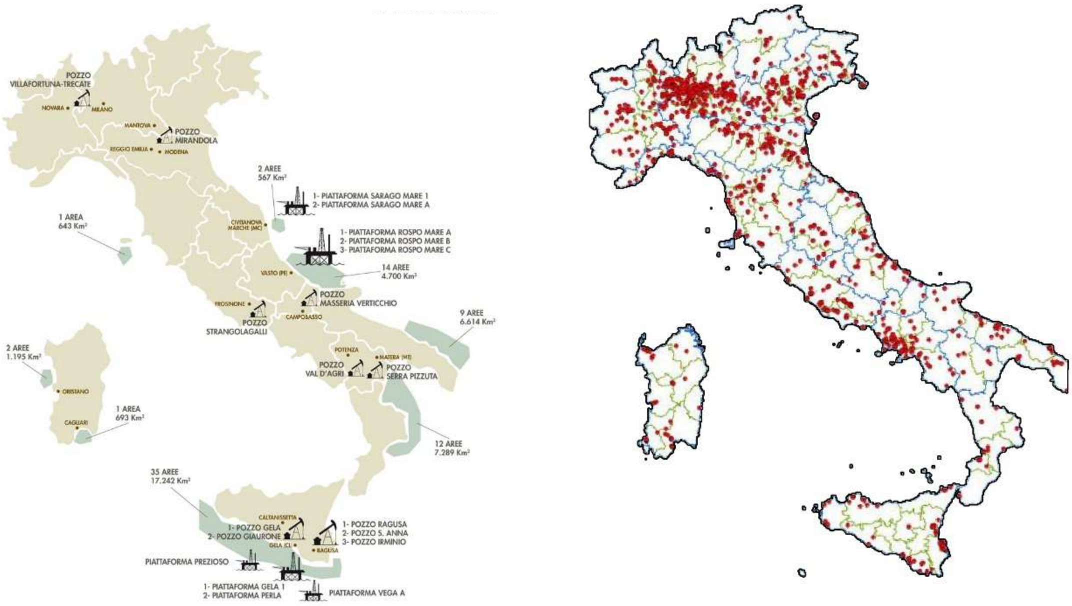


Figure 12 Map of Oil Extraction (Legambiente, left) and of Industrial sites (right)

1.2.5 Fire hazard

A further environmental issue concerns the forest fire risk, affecting the Mediterranean vegetation (Macchia) in the warmer months, when aridity, high temperatures and strong winds evaporate a part of the water held back by the plants, bringing about natural favourable conditions for fires to break out and spread.

About 30% of the territory in our country is made up of forests, marked by a great variety of species adapting themselves, during the course of millenniums, to the extraordinary variability of the climates, from the sub-arid ones in the extreme south of the peninsula to the nival ones in the Alpine arc. Italy’s forestry heritage, one of the biggest in Europe for extension and variety of species, is an immense wealth for environment and economy, the territory’s equilibrium, conservation of the biodiversity and countryside. Woodlands are moreover a natural habitat to many animal and vegetable species. Yet every year tens of thousands of hectares of woodlands are burnt either by wilful or culpable fire, linked with building speculation, neglect and carelessness of man. 12% of the domestic forestry heritage has been destroyed on the last thirty years. The consequences for the natural equilibrium are very serious and the times needed to restore the forestry and environmental ecosystem are very long. Moreover, the changes in the natural conditions of the soil caused by fires favour the instability phenomena on mountain sides causing the top strata of the soil to come away and slide downwards, with heavy rainfalls.

The total forest area of the country is 68.571 km² and the most affected zones are the South part of the Country, the islands, and the region of Liguria, instead during cold season forest fires can happen in the area of the South Apennine and Pre-Alps, due to a combination of dryness and cold winds from N-NE. The summer of 2007 is remembered as one of the most disastrous in the last few decades. Over 10 thousand forest fires broke out covering an area of over 225 thousand hectares with as many as 115 thousand covered by woodlands. The worst hit regions were Lazio, Campania, Calabria, Puglia and Sicily.

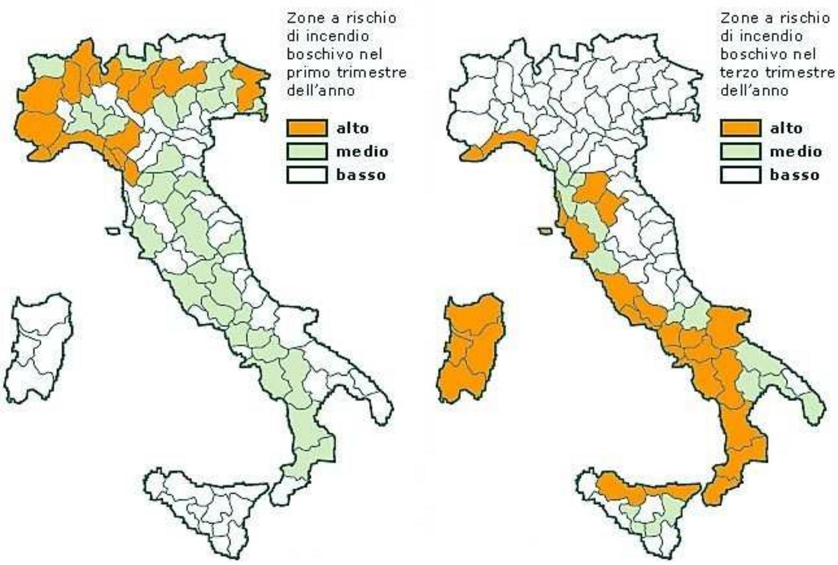


Figure 13. Fire hazard map (Corpo Forestale)

1.3 The Italian system of Civil Protection

The Italian National Service of Civil Protection involves the entire state organization: Municipalities, Provinces, Regions and the State, whose tasks are implemented by the National Department of Civil Protection (DPC) and operational structures (Navy, Armed Forces, Scientific Community, Fire Brigade, Red Cross, Volunteers, National Health Service, National Alpine Rescue and Speleology Corps). In general, when a disastrous event occurs, the DPC is able to define in a very short time the event's significance and assess whether local resources are sufficient to face up the event.

The hierarchical structure of the Italian Civil Protection system is made by four levels of public Administration, national level, regional, provincial and local. Each of these intervention levels corresponds its own structure of civil protection for the development of the functions within its competence.

The first emergency response, regardless of the nature, scale and effects of the event, is provided by the local structure through the activation of the Municipal Operation Centres (C.O.C). The COC is organized in a way to process some special functions (9 for municipalities and 14 for regions and provinces), using local resources and individuate according to the "Augustus Method". These "function" serves as a support to the management of the disaster event and to be deployed depending from the type of emergency event. The Mayor is the first civil protection authority and has the duty of assuring first emergency relief, and coordinating the local operative structures including the civil protection volunteers. In case of need, the action of the Provinces and Regions and the assistance of peripheral state administrations will be guaranteed and coordinated by the Prefects, who activate all the available resources (National Fire Brigades Forces, Police, etc.) in the areas affected by the calamity. In mayor emergency events, when the only local response is not sufficient, coordination and operational activities are organized through a multi-level hierarchical organization comprising the COC, the Mixed Operational Centres (C.O.M.) and Rescue Coordination Centres (C.C.S.) at the provincial level, the Regional Operations Centres at the regional level, and the Command and Control Direction (DI.COMA.C.) at the national level. In the most serious situations, the national authority takes charge of the operation. This role is owned by the DPC, which takes on the overall coordination of the operations, while regional, provincial and municipal levels perform their specific roles.

SUPPORT FUNCTIONS – AUGUSTUS METHOD	
1	Technical, scientific and planning
2	Health, veterinary, social assistance
3	Mass-Media and communication-information
4	Volunteering
5	Mean and materials

6	Transportation, traffic and road system
7	Telecommunication
8	Basic services
9	Goods and physical damage assessment
10	Operative structure S.a.R.
11	Local bodies
12	Dangerous materials
13	Assistance to the population
14	Operational centres coordination

Table 9. Support functions of the Augustus Method (DPC)

The Department coordinates the response to natural disasters, catastrophes or other events that for intensity and extent needs to be faced with extraordinary powers and means, provided by "State of Emergency Declaration"[2].

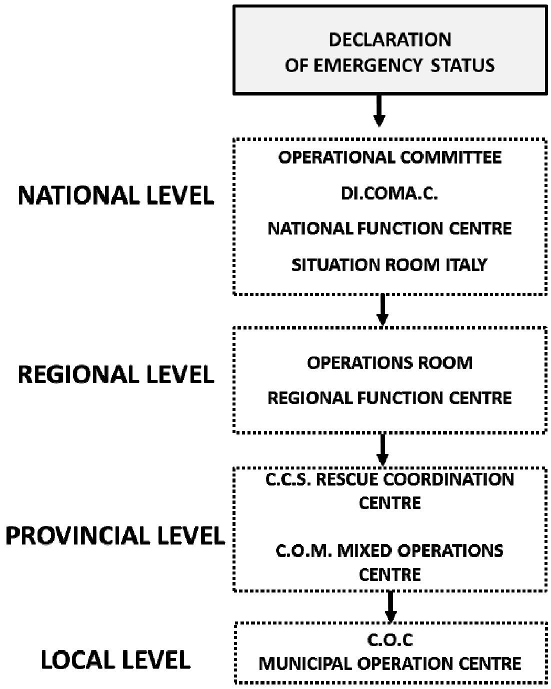


Figure 14. Emergency management structure

Within the DPC, an Operational Committee of Civil Protection, chaired by the DPC Head, and including the administrations and institutions involved at the national and local level, as well as operational structures (e.g. Fire Brigades, Armed Forces, etc.), representatives of the main research institutions (e.g. ISPRA, INGV, ENEA, etc.) and main service provider companies (e.g. power supply, telecommunication, transportation, etc.), has been created to ensure the joint management and coordination of the emergency activities. The operational Committee assesses the news, the data and the requests coming from the affected areas and coordinates the interventions and operational activities between the central and peripheral level.
Within the DPC, the National Situation Room (operational 24/7) has also been created to monitor and control accidents occurring throughout the country, collect information about on-going events, determine risks situations and alert the various components of the National Civil Protection Service participating in the emergency management. Furthermore, a network of Functional Centres has been set up at the central and local level to collect, process and share meteorological, seismic, volcanic and hydrogeological data.

[2]Interventions to face the emergency are regulated trough orders in derogation to the provisions of the law, in the limits and according to criteria indicated by the declaration of a state of emergency and in accordance with the law. The orders are issued and implemented by the Head of the Civil Protection Department. In the first order the Delegates Commissioner is nominated and is responsible for intervention to overcome the crisis. At the end of the emergency state a "closure order" is issued which govern the return of the ordinary administration and individuate the responsible for the post emergency.

2 Description of existing legal/policy and science approaches

2.1 Legal/policy and science approaches in relation to DRR

2.1.1 Legal/Policy approaches in relation to DRR

The structure of Disaster Management and the articulation of civil protection in Italy have evolved over several decades between one disaster and another (Alexander, 2010) and some legislative frameworks mark the most significant steps in this evolution.

Law 996/1970 is the first regulation defining an overall framework of civil protection interventions. This law considered only the emergency phase and outlined an embryonic system of civil protection organised around the National Fire and Rescue Service (Alexander, 2010). Before law 996 was fully implemented, two tremendous earthquakes in Friuli (1976) and Irpinia (1980) caused a large number of victims, respectively 976 and 2570, and massive destruction. Delays in relief operations, the absence of on-site coordination between volunteers and regional and local authorities, which mobilized with no due directions and precise operative objectives, and inefficiency in the reconstruction phase highlighted all the limits of the civil protection system. The idea began to take shape that scenarios already elaborated and **prevention** measures already enacted are needed to cope disasters before they occur. Not only as relief, but also forecasting and preventing started to be considered as phases where the involvement of Civil Protection is fundamental.

Law 938/1982 formalised the figure of the minister for coordinating civil Protection and the **Service Order of April 29, 1982** established the **Civil Protection Department**, an extra ministerial organisation supporting the minister and capable of coordinating all the forces which the Country may avail of. This department received all information and data about forecasting and preventing emergencies, realised the national and territorial plans of Civil Protection, organised the coordination and management of the emergency services, promoted the voluntary initiatives and coordinated the emergency planning for the purposes of Civil Protection.

Law 225/1992 finally established the legal framework of the national civil protection organization, marking the birth of the modern Italian Civil Protection system and defining the main features of the Disaster Management approach in Italy (Alexander, 2010; Pennisi di Floristella, 2014). By adopting this law, the Parliament approved the creation of the **National Civil Protection Service**, an umbrella institution coordinating the disaster management activities and centred on the role of different actors (public and private, scientific and academic sector and civil society), coordinated by a central authority (Pepe, 2009; Scolobig et al., 2014). The national disaster management policy is established by the President of the Council of Ministers and by mandate to the Minister for Coordination of Civil Protection who looks over the Civil Protection Department. This law identified the operational organizations of the National service: scientific research groups including the National Institute of Geophysics and Volcanology (INGV), volunteer forces, the National Fire-Fighters Corps; the Police and Armed Forces; the State Forest corps; the Italian Red Cross; the structures of the National Health Service and the National Alpine rescue and speleological corps. Relevant members are also the mayors, the prefects, and the presidents of the regional councils. The guiding principle for emergency management in Italy was based on **subsidiarity**. When municipal government capacities are insufficient for managing the scale of an event, they are supported by provinces and regions or the state, depending on what kind of event it is. When a disaster happens, also municipal and/or provincial, regional, and national operations centres (MOCs) are activated. Local emergency units work together to define the intervention strategy (Scolobig et al., 2014). The coordination of this complex system was assigned to the Prime Minister, who availed of the Civil Protection Department. Law 225/92 also defined the Civil Protection activities: apart from relief and activities aimed at overcoming the emergency, also **forecasting** and **preventing** activities were included. “Forecasting and Preventive Programmes” are established by the law within the activities to be carried out at regional and provincial level. In these programmes is necessary to identify– with sufficient certainty – all those areas and structures to be considered as “elements at risk” and included within the Emergency Plan, by imposing restrictions and regulations for safety of persons and goods. Moreover, concerning the alert and evacuation procedures, art. 4 sect. 3 had planned regular and periodic evacuation trainings, with the aim of keeping the population continually updated.
Anyway, introducing law 225/92, was clear the necessity to introduce a municipal level emergency plan: only the legislative decree n.112/1998 attributed to the municipalities, amongst others, the role of implement the emergency plans.

Therefore, the new system of civil protection defined by this legal framework is not only responsible of relief and assistance to the people, but also assesses the risks on the territory and provides all the actions necessary to avoid or keep the possibility of natural calamities causing damage down to a minimum.

Another innovative aspect of this law is the classification of disaster events based on their extent and seriousness. According to the class of the event ("A", "B" or "C"), the competent unit of the Civil Protection, both at a central and local level, to be activated is as it follows: A) municipal level, B) provincial and regional level and C) State level. This means that the lowest civil protection authority is the city mayor, responsible for planning and rescue operations within his municipality. In case of large disasters overwhelming local capacities, the responsibility escalates progressively through the provincial and regional levels to the state level (Pennisi di Floristella, 2014). Law 225/92 also established that the Council of Ministers, on a proposal by the President of the Council, can declare the state of emergency duration and extension. This regulation also introduced the National Committee for Forecasting and Preventing Major Risks to perform technical and scientific consultancy as regards forecasting and prevention of various risk situations. Law 225/1992 still remains the main legislative framework defining the civil protection structure. Nonetheless, over the last two decades a number of reforms have enhanced the role, responsibilities and competences of the Italian regions and local administrations.

In 1998, the so-called **Bassanini law (legislative decree 112/1198)** strengthened decentralization and transferred to the local authorities' tasks not specifically assigned to the central system. Even if Law 225/92 remains as reference framework, Civil Protection becomes a field of mixed competences. More specifically *national competences* are: (i) directing, promoting and coordinating the activities regarding Civil Protection; (ii) deliberating and revoking – in compliance with the interested regions – the state of emergency for type "c" events; (iii) issuing orders; (iv) drawing domestic up emergency plans (to cope with type "C" events) and organising drills. *Regional competences* are: (i) preparing forecasting and risk prevention programmes, on the basis of national directives; (ii) actuating the urgent interventions when type "B" interventions occur, also availing of the National Fire Brigade Corps; (iv)organising and employing volunteers. At the provincial level, *Provinces* (i) carry out activities of forecasting and risk prevention through the adoption of necessary administrative acts; (ii) prepare the provincial emergency plans and (iii) ensure that the provincial structures provide the urgent services to actuate in the event of emergency (type "B" events). At *municipal level*, the **local** authorities (i) have the duty of forecasting and risk prevention activities; (ii) prepare the municipal emergency plans; (iii) adopt the necessary measures and ensure the first relief operations and organised the use of volunteers and municipal Civil Protection.

This gradual process of decentralization culminated in the modification of the Title V of the Italian Constitution, (**constitutional law 3/2001**), which made the Civil Protection a competence matter of the Regions, by adding it amongst the subjects of "concurrent legislation". Significantly, the regional governments are entitled to building up their own civil protection structures matching the specificity of the territory and risk characteristics. It is worth mentioning also that the **Law 401/2001** introduced the so-called "great events" in the competence of the Civil Protection Department and extended to such events the use of extraordinary power normally employed in state of emergency (Pennisi di Floristella, 2014).

The Community Directive 2012/18/EU dated 04/07/2012, the so-called SEVESO III on the control of disasters related with hazardous substances was assimilated in Italy with le law 105 26/06/2015. SEVESO III, for the first time, deals with Na-Tech risks, introducing the obligation of evaluating, among the possible scenarios, the natural risks which may affect the industrial site/building and aiming at editing a Security Document as well as analysing the scenarios concerning the use of the precaution taken by the industrial company.

The recent **Decree Law no. 59/2012**, converted in the **law 100/2012**, is the most recent reform of the Civil Protection system. The structure of the system remains basically that defined by the law 225/1992, but important changes have been introduced, particularly regarding the definition of civil protection activities, the declaration of the state of emergency, and the issue of orders. They are summarised as it follows:

- alongside with the activities of "risk prediction and prevention" and "relief to the population", the concept of "overcoming the emergency" is better specified, and associated with any other necessary activity that cannot be postponed to "tackle the emergency" and "mitigate the risk" associated with natural disasters. Prevention activities are specified and for the first time early warning, emergency planning, training, dissemination of knowledge of civil protection, information for the public, enforcement and technical exercises are clearly introduced. The national alert system for weather, hydrological and hydraulic risk is framed in an organic manner, thus resuming the various measures that over the years have regulated alert activities with civil protection purposes;

- The first emergency phase is redefined, with emphasis on the "time factor". It is specified that the means and extraordinary powers to deal with disasters (type "C" events) should be used for time-limited and pre-defined interventions: the duration of the state of emergency rule cannot exceed 90 days, with the possibility of extension for further 60 days[3]. The state of emergency may be declared as "imminent" and not just "at the occurrence" of the adverse event and provides immediately - another important passage of the law - the identification of the competent authority in the ordinary way that carries on the activities, after the expiration of a state of emergency;
- The civil protection orders, necessary for the implementation of interventions to tackle and overcome the emergency, are normally issued by the Head of the Civil Protection Department and not by the President of the Council of Ministers, and their "spheres of interest" for the first time, are defined by law. The orders issued within thirty days of the declaration of a state of emergency are immediately effective, while the later ones require the agreement of the Ministry of Economy and Finance;
- The law confirms the role of the mayor as the municipal civil protection authority, stating the tasks in the relief and assistance to the population;
- The law introduces accurate fulfilments for the Municipalities, among which the term of 90 days of the entry into force of the law (12/10/2012) for the draw of the Municipal Emergency Plans, to be done according to criteria and modalities of the Civil Protection of each region;
- The law also defines some details concerning the last administrative management of "great events", after the law no. 27/2012 established that they are not anymore considered a civil protection issue.

2.1.2 National Emergency Planning

As in many other countries, in Italy the evolution of emergency management has responded to specific disasters that have opened the "window of opportunity" for legislative change. Since the late 60s, Italy has put considerable effort into developing a national system of emergency planning and management.

The national planning has the objective to define and coordinate rescue operations and assistance to face a disaster, event classified as "Type C". The national contingency plans are broken down by type of risk and related to specific areas of Italian territory, identified with the help of the scientific community, according to the expected intensity of hazards and the vulnerability of the territory.

The national emergency plan ensures the mobilization of all components of the National Civil Protection Service as a single organization of emergency, which combines central and local institutions, volunteer organizations and private enterprises, foreign countries and if necessary, to give first aid and assistance to citizens.

2.1.3 National Emergency Plan for volcanic risk

The national emergency plan for volcanic risk mainly concerns the Vesuvius and Campi Flegrei areas, both located in the metropolitan area of Naples, and considered two of the most dangerous active volcanoes worldwide, due to the intensity of the expected eruptions and the high density of population in the area.

In both case, the emergency plan is based on Sub-Plinian explosive events that will generate ash fallout, pyroclastic flows and lahars. The related hazards have been carefully evaluated, including the limits of the so-called "red zone", exposed to pyroclastic flow hazard, where there is a very little survival possibility for residents who therefore need to be evacuated before the eruption onset. The attention of the plan was dedicated mostly to the quick evacuation of the persons living in the red zone (nearly 700,000 in the case of Vesuvius), including the selection of an emergency road network. The structure of the plan identified different areas of attention in relation to the hazard phenomena (e.g. in the case of Vesuvius the red zone 1 is exposed to pyroclastic flows; red zone 2 to ash fallout levels which are likely to cause extensive roof collapses; yellow zone to minor levels of ash fallout which do not require population evacuation).

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[3] One year later, the law n. 119 of October 15, 2013 again amends law 225/1992 by acting on the duration of the state of emergency on areas of intervention of civil protection orders and the definition of the resources needed to cope with the emergency. In particular, Law 119/2013 provides that the duration of the state of emergency cannot exceed 180 days and may be extended for further 180 days. Normally, the competent authority at the end of the state of emergency is no longer detected in the deliberation of the state of emergency of the Council of Ministers, but in the takeover order that is issued at the end of the state of emergency.

The national plan is based on the expected scenario and identifies four levels of alert: base, attention, warning, alarm, which correspond to subsequent operational steps, which mark the times of civil protection measures to secure the population and territory. The emergency plan for the Vesuvius areas has been last updated in November 2015 (DPCM 16/11/2015), and the emergency plan for Campi Flegrei last updated in June 2016 (DPCM 24/06/2016). The update of Vesuvius emergency plan represents an interesting example of effective dialogue between science and policy: the definition of the “red zone 2” (and thus the increase in the number of population to be evacuated) was introduced following the results of more refined ash fall impact scenarios produced by DPC Competence Centres based on the reference event. At the same time, it is important to note that the the revision and update of emergency plans for such high-impact scenarios should be considered a continuous process aimed at ensuring the effectiveness of evacuation procedure. As an example, according to the current and updated version of the Vesuvius plan, the evacuation order will be issued by DPC if Vesuvius Observatory monitoring network record clear precursory signals of the eruption, which include shallow M=4 earthquakes. A study by PLINIVS-LUPT (Competence Centre of DPC) of the seismic vulnerability of the buildings facing the roads to be used in the emergency evacuation has revealed that they will be severely damaged by those earthquakes and their collapse, besides creating damages and casualties, will affect the red zone evacuation operations. In the current version of the plan this delicate aspect is not taken into account and could be an important advancement to introduce in the next update.

2.1.4 National Planning and Regulations for Seismic Risk Prevention

The National government has started to take increase its activity for seismic risk emergency planning in the 80s when the Irpinia's earthquake took place (important previous events were in 1968 in Sicily and 1976 in Friuli Venezia Giulia Region).

The investigations developed after Irpinia earthquake have established that the principal cause of the collapse of buildings are due to from the wrong location of urban settlements (on slopes or crowns).
Orders and laws following the Irpinia earthquake (see Ministry of Public Works Decree n. 07/03/1981; Law n. 219/1989 and Ministry of Public Works Decree n. 515/1981) can be considered as the basis for the Order n. 3274 of 20/03/2003 about the seismic classification of the national territory and technical regulation and building codes in seismic areas, with particular focus on “strategic buildings and infrastructures”, such as schools and hospitals.

In terms of damage to “strategic public buildings”, an important push to the legislative evolution came after the M=6.0 earthquake of October 2002 at San Giuliano di Puglia, in which 27 children and 3 teachers were crushed to death when a school collapsed. Especially after this event, seismic checks on schools and interventions of structural and anti-seismic reconstruction to reduce the effects of the earthquakes have started – the so-called extraordinary plan for school safety – first with the Budget law of 2003 and then the Budget law of 2008. After the Order 3274, some regions have started local programs of seismic evaluation of public strategic buildings as the case of Basilicata region and its “Hospitals Programme” of 2004 and the “Schools Programme” of 2005. At national level, concerning public strategic buildings has put in place a database on public schools (Registry of school buildings) with the aim of monitoring and evaluating the condition of buildings ante and post a disaster event. At the same way, the Ministry of Health, in collaboration with the Civil Protection Department, Regions and Local Health Service, since 1999 has started the compilation of data sheets on structural and installation conditions and in way to evaluate seismic vulnerability of hospitals.

After the Abruzzo earthquake of 6 April 2009 a new legal measure was issued in order to give a stronger push to seismic prevention. Article 11 of decree no. 39 of 28 April 2009 provided for the funding of seismic risk prevention works on the whole national territory and allocated 965 million euros in 7 years. The relation between the safety checks on strategic buildings directly implies important considerations concerning the consistency of safety monitoring and risk prevention policies. Safety checks showing high vulnerability should entail immediate risk reduction measures (or the closure of such structures, which in most cases produces unacceptable social impacts), but the funding limitations and the administrative constraints do not allow at the moment to streamline this virtuous process. Since 1 July 2009, with one year of advance with respect to the scheduling and connected to the disaster of L’Aquila, has entered into force the Ministry of Infrastructure and Transport Decree 14/01/2008, also known as NTC2008 (Technical Buildings Regulations and Standards).
Following the earthquake in Abruzzo, the Order n. 3843 of 19/01/2010 established a Commission of ten experts in seismic risks and set general objectives and criteria for effective prevention actions for the seismic risk on the

whole national territory. Funds have been made available from Law n. 77 of 24/06/2009 (art. 11) extended to the whole national territory. Preventing actions are related mainly to the seismic microzonation of the territory, so to update land use regulations and other structural intervention on private buildings through special funds addressed to structural improvement of buildings. The total addressed amount is about 44 million euro for the year 2010; 145,1 million euro for the years 2011 and 2015, 195,6 million euro for the years 2012-2014 and 44 million euro for the year 2016.

After 180 days of the state of emergency, procedures for reconstruction and funding mobility is subjected, case by case, to specific rules, such as the case of decree n. 77 of 24/06/2009 after the earthquake of L'Aquila and decree n. 189 of 10/10/2016 after the earthquake in Central Italy. Reconstruction plans and programmes, in principle should propose possible concrete intervention based on the assessment of the state of deterioration – from urban to building scale – aiming at recovery the previous situation of the affected area for persons to return in their pre-event homes. Those plans and programmes also propose actions for the enhancement and socio-economic conditions of places and inhabitants and in some case are reasons to experiment new technologies and strategies of urban planning in seismic areas.

Different approaches can be found in the Italian recent history, showing how different policy and governance priorities.

Following the Umbria-Marche earthquake in 1997, in order to ensure a unitary and coordinated reconstruction of destroyed or damaged buildings, Integrated Recovery Programs (P.I.R.) have been adopted, conceived as urban reconstruction programs based on a careful financial programming.

In addition to the reconstruction or recovery of private and public buildings, the P.I.R. are aimed at the realization of the primary and secondary urbanization of the area concerned and, above all, in the restoration of the sites in a short time. The strategic choice was therefore to focus on the reconstruction of damaged urban centers, limiting the construction of new buildings in derogation to urban plans without aggravating the conditions of the affected population, considering that three months after the first shock the provisional camps were dismantled.

After the earthquake of L'Aquila, a different strategy was proposed, pushed by the presence of a high number of homeless citizens of L'Aquila needed temporary housing, waiting for the reconstruction of their homes. The Italian Government considered these events to trigger the controversial C.A.S.E. project, comprising 185 seismically isolated and environmentally sustainable buildings, for 15,000 people, built in just 8 months in 19 areas of the municipality of L'Aquila, with a budget of 792 million euro.

2.1.5 Regional and local planning

The regulatory framework foresees that Regions, in collaboration with Provinces, provide specific guidelines for the draft of the Municipal Emergency Plan.

Each of the 109 provinces in Italy has a government office, or prefecture, and a provincial Prefect, who is the chief representative of central government at the local level. Prefects have responsibility for police and fire services and hence were identified in the 1992 law as the co-ordinators of emergency response at the intermediate level.

Regional and provincial guidelines contain a comprehensive overview of the land structure, in terms of population, infrastructures, exposed elements and goods, event and impact scenarios, local resources, maps, etc. Such data, being changeable, lead to modifications of the impact and event scenarios: Regions and Provinces have specific tasks to update data to be used by Municipalities for the draft of the emergency plan.

Regional guidelines also contain a description of the most relevant catastrophic events that could happen in that specific territory and provide strategic guidance to be taken by Municipalities.

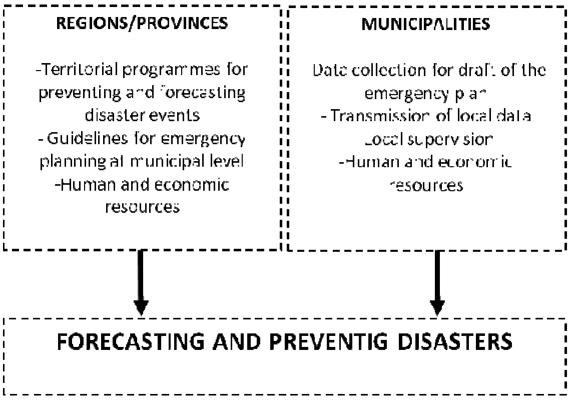

Figure 15. Tasks of the involved actor

In operational terms disasters must be tackled primarily at the local level. In Italy, this means the 8104 municipalities, whose mayors are identified by Law no. 225/1992 as the chief local authority for civil protection.
The General Civil Protection Plan at Municipal level is structured on the principle of subsidiarity, differentiation and adequacy, taking into account the response capacity at municipal level and the intensity and extension of the event. The structure of the general plan consists in the Civil Protection Regulation and system of documents interconnected according to the type and the intensity of the event: Municipal Emergency Plan, Detailed Plans and Operative Procedures.
The Civil Protection Regulation includes indications about Members and Bodies of Municipal Civil Protection as well as offices and operative resources. The Regulation also defines guidance for the draft update of the plan, and regulates the public participations within the mechanism of the Civil Protection.
The Municipal Emergency Plan summarises all the information about the territory, the possible disaster events, the relevant structure and infrastructure, the alert and monitoring-communication systems. The Municipal Plan also establish the general and specific objectives as well as the financial resources to be used.
The Detailed Plans are related to specific typologies of risk, in terms of building the risk profile and assessment and evaluate the amount exposed, establishing the intervention strategy and model.
The methodology used in the field of urban planning is also used within the framework of the Civil Protection planning: decisional processes are organized according to a “waterfall model” related to the territorial scale and its governance rules as well to the plans and programs which derive from them. In this context, the “Municipal Emergency plan” is of higher level compared to local urban plans.

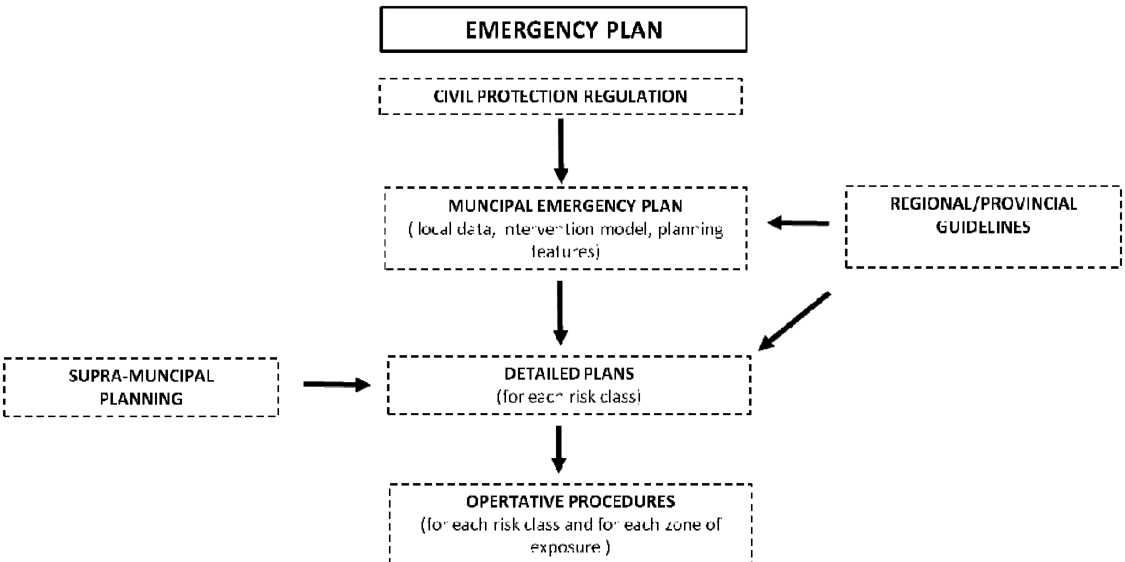

Figure 16. The general emergency plan hierarchy

Italian regions	Number of Municipalities	Number of Municipalities with Emergency Plan	% Municipalities with Emergency Plan
Abruzzo	305	301	99%
Basilicata	131	123	94%
Calabria	409	219	54%
Campania	550	214	39%
Emilia-Romagna	334	322	96%
Friuli Venezia Giulia	216	216	100%
Lazio	378	249	66%
Liguria	235	196	83%
Lombardia	1.544	1.209	78%
Marche	239	239	100%
Molise	136	136	100%
Piemonte	1.206	1.119	93%
Province of Trento	210	210	100%
Puglia	258	256	99%
Sardegna	377	283	75%
Sicilia	390	190	49%
Toscana	276	250	91%
Umbria	92	91	99%
Valle d'Aosta	74	74	100%
Veneto	581	497	86%
Total	**7.941**	**6.394**	**80%**

Table 10. Distribution of existing Emergency Plans

2.1.6 Science Approaches in relation to DRR

A reliable DRR policy is based on two main pillars: risk assessment and risk prevention. Risk assessment requires a correct knowledge of (i) the hazard (i.e. the probability of occurrence, in a given time and within a given part of the territory, of a dangerous natural phenomenon) and (ii) the vulnerability and value of the elements at risk (e.g. buildings and infrastructures) exposed to hazards. Risk prevention implies two different actions or types of intervention, which may be called “non-structural” and “structural”, respectively.
Non-structural interventions are based on the scientific capability of forecasting the hazardous event (time, place and intensity) and of adopting pre-established emergency plans for life safeguarding, which often consist of a mere evacuation of people from the most exposed zones. Structural interventions are instead directed to reduce the risk by reducing the vulnerability (e.g. structural strengthening of buildings in seismic areas) or the hazard (e.g. consolidation of an instable mountain slope, creation of a flood expansion basin, diversion of a lava flow).

Science approaches have been oriented to support DRR policies in this perspective, developing methods and tools to enable effective emergency planning and land use implementation, often based on simulation tools whose results become an input for decision makers in the development of policies and regulations aimed at DRR along the entire disaster risk cycle.

The various phases of the disaster risk cycle are supported by a number of science-based tools. The preparation of these tools in Italy is demanded to a number of different agencies and authorities. This means that there is no single document combining all risks and the system is ‘‘single risk centered’’ with different authorities providing maps and tools for integration into land use and urban planning (Scolobig et al., 2014).
The systematic assessment of **landslide/flood** hazard, risk, and vulnerability is performed by the river/district basin authorities, regions and autonomous provinces which provide plans based on hydrogeological hazards maps (Law 183/89, Law 267/98, Legislative Decree 152/06, Legislative Decree 49/2010). The evaluation of flood and landslide risk is conducted at the level of each hydro-graphic district in those areas where the hazard maps together with information on land use and a vulnerability assessment show that potential risks from landslides or floods are significant. These maps are based on a four levels risk classification scheme. They aim at showing how risk varies in terms of potential economic damages, potential number of people at risk and adverse consequences for the environment.

Currently, a work of updating, homogenizing and enhancing of the flood hazard and risk maps is ongoing, based on the information derived from data already contained in existing planning tools (PAI) in order to have, at a national level, a single system of shared and uniform representation of the conditions of hydraulic hazard and risk, consistent with the indications from the article 6 of the Legislative Decree 49/2010.
In addition to the risk maps, the plans provide measures to limit land use in order to not increase the risk level and identify the main protection actions to reduce or to remove the hydrogeological risk. They are under continuous upgrading through the updating and implementation of events, scenarios and consequent countermeasures.

The CNR-IRPI and the CIMA Foundation (International Environmental Monitoring Center) are two of the National Competence Centers for hydrogeological and hydraulic risk. CIMA conducts activities for the adaptation, maintenance and upgrading of systems for collecting, treating and sharing hydropluviometric information and forecasting system for the hydrological weather monitoring in real time. It also conducts supporting activities and technical-scientific and operational assistance to the system of the National Meteorological Radar Network and the Central Functional Center. The CIMA Foundation, in the framework of the Convention with the Civil Protection Department, has developed an integrated operating system, called Dewetra, for the management of hydro-meteorological information for risk reduction. This system enables Central and Regional Functional Centers to synthesize, integrate and compare data and models required for instrumental monitoring, supervision and shared assessment of risk scenarios and their possible evolution. The main applications are related to the fires and floods identified as priorities for their frequency and diffusion on national territory. Dewetra has been made available to the Regions as a tool to support and simplify the challenging daily monitoring activity.

With regard to **earthquakes,** seismological and engineering scientific support to DPC is provided mainly by three Competence Centres for Seismic risk: INGV, the National Institute for Geophysics and Volcanology, ReLUIS, the network of research laboratories of earthquake engineering, EUCENTRE, the European Centre for Training and Research in Earthquake engineering. INGV is the institution which has produced the national seismic hazard map (National Ordinance 3519/2006) and is in charge the seismic surveillance of the Italian territory. ReLUIS (www.reluis.it) and EUCENTRE (www.eucentre.it) have a strong attitude towards the experimental research and the training of young scientists and professionals. The ReLUIS consortium is a laboratory network involving several Italian universities in experimental activities. The EUCENTRE foundation is an international reference centre for both research on seismic risk and training, also due to the synergy with the international Rose School. Scientific projects of the competence centres are funded by DPC, on a three-year contract basis. Their objectives are oriented, and relevant activities are monitored, by DPC, in order to finalise scientific results towards products of immediate interest for Civil Protection purposes. As far as the knowledge of the territory is concerned, several actions have been carried for its improvement during the last years. The most important actions are related to the public and the private building stocks and to the seismic microzonation of the built areas (i.e. the LSU (Socially Useful Works) project, aiming at collecting the most important features of buildings related to their vulnerability and their use, through visual inspection that was carried out in 1996 on the strategic public buildings in Southern Italy; the provisions of the Ordinance 3274, passed on March 20, 2003, after the San Giuliano earthquake, that require the seismic safety check, according to the seismic code, of all the buildings and infrastructural constructions of strategic importance as well as those of great importance in relation to the consequences of their collapse (e.g. schools)). As far as private buildings are concerned, their seismic risk is evaluated at national level by using the data drawn from the population census carried out every 10 years. An agreement of DPC with the National Institute for Statistics (ISTAT) allows DPC to get uniform and complete exposure data on the population and on the private building stock, all over the national territory. Seismic risk is then evaluated by DPC as well as by the competence centres, such as, ReLUIS, EUCENTRE and PLINIVS-LUPT, using different criteria and algorithms. Extensive surveys by visual inspection of damaged and non damaged buildings were also carried out after all the recent destructive earthquakes in Italy, providing precious data bases to calibrate the vulnerability functions of different building types that can be found in the Italian territory. Damage data, along with their structural characteristics, have been collected on some hundreds of thousand buildings since 1976. The National Group for the Defense against Earthquakes (GNDT) in the past (Zuccaro, 2004), have also carried out surveys on samples of building stocks, in order to calibrate the specific features of buildings and thus improve the vulnerability estimations based on the ISTAT census. The competence centres are also contributing to the improvement of knowledge on the seismic risk of the Italian territory, not only by making preparatory studies, but also by setting up tools and using them in order to make an evaluation of the seismic risk of the school system as well as the highway and road transportation systems, whose validity is again at a statistical level. To be mentioned are also the tools and studies on the seismic resistance of harbors and earth dams, made by EUCENTRE (e.g. Bozzoni, Lai, 2012). As far as the improvement of the knowledge on the local hazard are concerned, almost all of the microzonation studies were carried out, until few years ago, after destructive earthquakes, mainly in the epicentre areas, as a tool for the reconstruction activities. This has occurred since the 1976 Friuli Earthquake. Only recently in few Regions, microzonation studies have been carried independently of the occurrence of earthquakes, as preventive tools for urban and emergency planning.

Activities to manage **volcanic risk** in Italy are conducted mostly at the national level by the Civil Protection Department, either directly or jointly with other agencies or Competence/Functional centres. There are not specific guidelines for the warning, but national emergency plans have been drawn up, which describe the characteristics of the monitoring system and the procedures according to the level of alert. Risk prevention measures include the emergency plans drawn up on the basis of one or more eruptive scenarios and corresponding hazard maps. The plan includes emergency actions and evacuation instructions for the local population.

The effects of a volcanic eruption on a built environment have been investigated in the last decades, defining a comprehensive framework of studies, surveys, and simulations that include all the different eruptive phenomena and their possible impacts on existing buildings and infrastructure. Nevertheless, to define Disaster Risk Reduction strategies in volcanic areas – such as the Campania Region – a broader approach is needed. In fact, a basic consideration is that the cumulative effects given by a complex eruptive scenario (such as a sub-Plinian or Plinian eruption) produce extremely variable impacts. Thus, the effects depend on the specific time history of the event, on the building typologies, and on their grade of vulnerability (Zuccaro et al. 2008).

This specific approach has been formalized to evaluate the impact of a sub-Plinian eruption in the Vesuvius and Campi Flegrei area (Zuccaro et al. 2008) through the development of a numerical model for the definition of impact scenarios. A dynamic model able to evaluate the cumulative damage distribution in time and space was also developed within several national and international projects such as Vesuvius (Human Casualties and Structural Vulnerability consequent to a possible eruption of Mount Vesuvius, EU-FP5, 1998 – 2000), Exploris (explosive eruption risk and decision support for EU populations threatened by volcanoes, EU-FP6, 2002 - 2005) and SPeeD (Hazard and Damage Scenarios for Campania Region Volcanoes 2007–2009). The eruptive phenomena considered are the following: earthquake (EQ), ash fall (AF), pyroclastic flow (PF), and lahars (LH).

The basic assumption is that the impact damage due to a volcanic eruption depends on several disastrous events whose effects are cumulated in the final scenario. The damage level along the eruptive history is strictly linked to the number of events, the range of the intensity of the events, and the distribution in time and space (Zuccaro et al. 2008). The final volcanic impact scenario can be examined by parameterizing the cumulative damage on selected elements at risk (e.g. population, buildings, critical infrastructures, road and service networks, economy) due to the possible sequence of events.

The Volcanic Impact Simulation Model developed by PLINIVS Study Centre of University of Naples Federico II as Centre of Competence of the National Department for Civil Protection (DPC) is a tool available to the Italian Civil Protection decision makers to quantify the potential losses consequent to a possible eruption of Vesuvius or Campi Flegrei. The impact scenarios produced by the model are used for the drafting and updating of National Emergency Plans of Vesuvius and Campi Flegrei. The main hazard parameters related to the diverse expected volcanic phenomena (EQ, AF, PF, etc.), as input of the impact model, are provided by the National Institute for Geophysics and Volcanology (INGV), in relation to various parameters (e.g. AF in relation to wind direction, PF in relation to Volcanic Explosive Index assumed, etc.). The results are strongly dependent on the hypothesis assumed and on the parameters used as inputs. Therefore, the “single-shot” output scenarios must be taken into account with great caution, given the considerable range of uncertainty in play. Nevertheless, considering the reliability of each single scenario, once the input data have been defined, a comprehensive overview of the possible different situations likely to occur, with different ranges of probability, represents an important reference for emergency management and decision makers. In fact, it allows for a proper assessment of the resources needed to improve the arrangement of measures needed to face the event and to enhance the implementation of feasible and effective mitigation measures on buildings and infrastructure to reduce the expected damage (Zuccaro and Leone, 2012).

Within a recent European project (EU-FP7 Snowball) the capabilities of the PLINIVS Volcanic impact simulation model have been extended to include the impact of cascading effects of a volcanic unrest (in both cases of eruption/no eruption) on critical infrastructures and service networks.
The extension of the model and the link with a multi-criteria analysis tool allows to test the effectiveness of alternative long-term (e.g. buildings and/or CIs retrofitting) or short-term (e.g. population evacuation) Disaster Risk Reduction measures.

The updated version of model allows to identify the potential trans-boundary effects on air transportation and disruption of power and telecommunication systems due to the dispersal of the ash plume according to the eruption intensity and wind direction. An ongoing update is related to the "automation" of the Ash Fall impact model through a web service able to update the results every 6 hours by automatically running the models which operate remotely on the INGV and PLINIVS servers, and sending the results as a report to the DPC.

A number of agencies, services, research institutes and universities cooperate in the activities for risk assessment and early warning. Here below we report the list of Competence Centres included in the law 1349 of 14/04/2014updated in 24/05/2016.

	Competence centre	Tasks and functions	Hazards/risks
Administrations / Agencies	**AGEA - Agriculture Agency**	Builds and updates the data for soil use or for analysis and mapping of phenomena related to the forest or agricultural territory such as soil erosion, forest fires, and monitoring	Landslides and fires
	National office for Civil Aviation	Defines the procedures and intervention plans to guarantee safety in the transport of goods and people	All (focus on fires)
	Aineva - **Interregional Association for Snow and Avalanches**	Processing, Exchange and dissemination of information and methodologies on scientific and technical issues related to the prevention of avalanche hazard	Snow and avalanches
	ARPA – Regional Prevention and Environment Agency	Monitoring of pollution levels in air, water, soils, noise and electromagnetic pollution; monitoring of general climate, air, water and soil properties.	Environmental
	Aipo - Interregional Agency for the Po River	Develops procedures for managing flood warning service and emergency service in local districts. Creates a system of hydraulic modelling for prediction and control of floods on the main trunk of the Po river.	Floods
	The Upper Adriatic river Basin Authority	Analyzes the geological, hydrogeological risk zoning and plumbing, through inventory and historical analysis of events, both the use of modeling of events and of the territory, both the monitoring over time of the evolution of the land, soil and water	Landslides and floods
	The Arno river Basin Authority	Analyzes the zoning of geological, hydrogeological and hydraulic risk through inventory and historical analysis of events; creates a system of hydraulic modelling for prediction and control of floods.	Landslides and floods
	The Volturno and Liri Garigliano river Basins Authority	Analyzes the zoning of geological, hydrogeological and hydraulic risk through inventory and historical analysis of events; creates a system of hydraulic modelling for prediction and control of floods.	Landslides and floods
	The Po river Basin Authority	Analyzes the zoning of geological, hydrogeological and hydraulic risk through inventory and historical analysis of events; creates a system of hydraulic modelling for prediction and control of floods.	Landslides and floods
	The Tevere river Basin Authority	Analyzes the zoning of geological, hydrogeological and hydraulic risk through inventory and historical analysis of events; creates a system of hydraulic modelling for prediction and control of floods.	Landslides and floods

	Asi - Italian Space Agency	Provides applications, products, services, information and data acquired in the real-time for forecasting, monitoring and emergency management.	All
	Cnmca – National Centre of Aeronautical Meteorology and Climatology	Provides wheatear forecast on the whole National territory; Shares data coming from the European Centre of wheatear forecasts.	Snow and hydrogeological
	CNR - National Research Council	Develops knowledge and methodologies for the monitoring and forecasting systems for the assessment of risk, especially connected to wheatear or climate factors.	Hydrogeological and water pollution
	General Management of Dams and energy and water infrastructures – Ministry of Infrastructures and Transports	Provides support activities to the operational centers through the analysis of hydrogeological - hydraulical phenomena in presence of important dams.	Hydrogeological and hydraulic
	Regulatory bodies of big Alpine lakes	Defines procedures to ensure security and regularity in passengers and good transportation.	
	Ibimet – Institute of Biometeorology	Participates at the development, execution and control on a forecasting system for the anomalies of temperatures and rainfalls	Climate
	Igag – Institute for Environmental Geology and geological engineering	Provides knowledge activities in the field of hydrogeological and hydraulic risk through the elaboration of guidance and operational procedures	Hydrogeological, hydraulic and coastal
	Imaa - Institute of Methodologies for Environmental Analysis	Provides knowledge activities for the integration of techniques in situ and techniques of remote-sensing for the assessment of climate and hydrometeorological indicators.	Hydrogeological and climate
	Inea - National Agricultural Economic Institute	Enhancement of the environmental resources and management of hydric resources; support the definition of tools and provision of information for economic and structural analysis in agriculture.	
	National Institute for Geophysics and Volcanology – National group for Volcanology – National group for earthquakes defense	seismic and volcanic monitoring, technical-scientific consultancy, seismic and volcanic risk studies on the national territory responsibility for seismic hazard overall the national territory through instrumental networks on the national territory or concentrated around active volcanoes maintenance of an effective first aid network transfer of scientific and technical data to the National Major Risk Commission prepares and develops a research programme to obtain a better knowledge of the possible scenario of seismic and volcanic hazards	Earthquakes and volcanoes
	Ispra Institute for Environmental Protection and Research, ex Apat	Sharing of information with Central Functional Centre and offices of Departments about the diverse typology of risk.	Seismic, hydrogeological, nuclear, environmental
	Irc - Research Institute on combustion	Provides analysis and studies on technologies of electric and heat energy production, technologies using biofuels and phenomena of involuntary combustion linked to	Fire risk and industrial risk

		industrial, chemical and oil processes.	
	Irea - Institute for the Electromagnetic Survey of the Environment	Develops methodologies and tools for the analysis and the elaboration of remotely sensed data with the aim of evaluating ground deformations and, in particular, integrating satellite and on the ground information.	
	Irpi - Institute for Hydrogeological Protection of the National Research Council	Develops methodologies to identify processes of initiation of landslide including mapping, and real time monitoring and evaluates dangerousness of landslides.	Landslides
	Irsa - Water research institute	Develops methodologies, models and procedures to be used in real time at the Functional Central Centre for the definition of risk scenarios from accidental pollution events. Develops informative systems on vulnerability of water infrastructures of strategic interest and develops intervention guidance for reducing, preventing and managing the risk.	Water pollution
	Isac - Institute of Sciences of the Atmosphere and Climate	Enhances and strengthens the forecasting capacities of wheatear models; develops acquisition methods, processing and assimilation of radar data for cloud observation and monitoring in the real time.	Hydrogeological and snow
	Itc - Institute for Buildings Technologies		
Universities	**Earth science department – Firenze University**	Develops and organizes the national monitoring and surveillance system for hydro geological risk sets methodologies to identify triggering factors and related models and scenario develops hazard assessment, mapping, monitoring and real time analysis of risk scenario localized analysis and monitoring of risky areas with sensors volcanic risk monitoring and surveillance (Stromboli) educational activities for the national department of civil protection or the regions	Hydrogeological risk/volcanic risk
	CAMIlab – Laboratory of environmental cartography and hydrogeological modeling University of Calabria	Develops mathematical models useful to the Network of Functional Centers for real-time forecasting of hydrogeological events, in particular flood flow patterns for flood forecasting and hydrogeological models for real-time forecasting of landslide movements	Hydrogeological
	Excellence centre in remote sensing and severe events forecasting models of L'Aquila University	Develops operative chains of modelling and develops techniques for the evaluation of meteorological products develops new radar methodologies and technologies and elaborates the data for post evaluations monitors volcanic clouds	Volcanic / hydrogeological
	LABMOT - Department of Design - Polytechnic of Milan	Provides methodological and operational support in the drafting of Urban Traffic Plans, Transport Plans and urban and extra-urban mobility management as well as information on transport risk in general and on the road network.	Transport accident
	Research Centre PLINIVS on hydrogeological, volcanic and seismic	Research on hazard, risk and vulnerability assessment as well as on risk mitigation data collection for: buildings exposed to volcanic risk analysis of the impacts of these phenomena on buildings	Hydrogeological/ volcanic / seismic

	engineering	and people	
	SDA Bocconi School of Management	Strategy and Public Administration Guidelines, Reform and Innovation, Service Delivery and Stakeholder Relations, Programming and Control Systems, Processes and Procedures, Public-Private Partnerships and Finance Tools, HR Management and People Development, Procurement, Modernization of administrative apparatus, management of public services	
	UORECI - Department of Chemistry - University of Venezia	Assessment and definition of the impact on population and environment. It estimates the immediate consequences and environmental follow-up, detects pollution of surface and underground water bodies and identifies emissions of atmospheric pollutants.	Environmental, industrial
Consortia and foundations	**Inter-university consortium - Reluis**	Supports technical emergency management activities, in particular regarding post-seismic damage assessments and post-seismic assessments of strategic or relevant buildings and structures; develops nationally integrated research programs in seismic engineering, with the involvement of universities, research organizations and private individuals; training and communication activities.	Seismic
	Inter-university consortium - Conprici	Hazard and impact assessment. Analyzes the possible formation of new toxic or dangerous substances as a result of major accidents as well as interference of the transport system with the industries at risk and assesses environmental damage resulting from industrial accidents.	Environmental, industrial
	Cima Foundation - Fondazione Centro interuniversitario di monitoraggio ambientale	Non-profit research organization committed to the promotion and support of scientific research, technological development and training within the fields of Civil Protection, Disaster Risk Reduction and Biodiversity.	Hydrogeological, environmental
	Eucentre Foundation - *European Centre for training and research in earthquake engineering*	Non-profit entity which supports training courses and research activities in the field of seismic risk reduction.	Seismic

Table 11. Centres of Competence of the National Department of Civil Protection

The assessment and planning in the **forest fire fighting sector** is based on guidelines issued by the Department of Civil Protection regarding forest fire emergencies and under the direct responsibility of the regions. Each Region has the competence to organise its fire fighting system, including prevention and planning activities. Regional plans for forecast, prevention and active struggle against forest fires have to work out risk assessment, considering both predisposing factors and causes.

Mapping of the forests is planned on the regional level but implementation is on the local level which is obliged to assess the risk and have maps indicating the areas where there should not be commercial or residential exploitation of land. Vegetation features, geomorphological and meteorological conditions, human factors (e.g. human behaviours), urbanization levels, road conditions and socio-economic features have to be taken into account. A municipal land register of the areas subjected to fire emergencies and local emergency plans with the respective interface areas have to be realized.

2.2 Legal/policy and science approaches in relation to CCA

2.2.1 Legal/Policy approaches in relation to CCA

In Italy the protection of the environment, ecosystem and cultural resources are under the exclusive competences of the central Government. The Italian Ministry for the Environment Land and Sea (IMELS) is responsible for the adoption of the National Strategy on Adaptation to Climatic Change. Also the Inter-Ministerial Committee for Economic Planning (CIPE), a collective governmental body chaired by the President of the Council of Ministers, has competences related to climate change.
Adaptation to climate change is more related to the country's specific features. In such a context, firstly, assessment of local and regional vulnerabilities is needed; secondly, on that basis, it is possible to take appropriate action to prevent or minimize the damages of climate change. Consequently, with respect to adaptation, the EU Member States have more flexibility to determine and implement their own national adaptation strategies.
As required by the White Paper of the European Commission (EC,2009) on June 16, 2015, the Italian Ministry for the Environment, Land and Sea (IMELS) formally approved the National Strategy on Adaptation to Climate Change (NAS) while the National Adaptation Plan (NAP) for the implementation on the NAS is still in progress. The NAS responds to the broader goals set out in the adaptation strategy package adopted by the European Commission in April 2013, with the aim of making Europe more climate-resilient. It provides a National vision to address climate change adaptation, actions and guidelines to build adaptive capacity, and concrete proposals about cost-effective adaptation measures and priorities. The Italian strategy sets out principles and measures with the aim of:

- reducing risks that arise from climate change;
- protecting public health;
- preserving natural heritage;
- maintaining and strengthening the resilience and adaptation capacity of natural, economic and social systems; and
- taking advantage of potential benefits that new climatic conditions may create.

Notably, it also contains measures to reduce adverse climate impact on cultural heritage and is the first adaptation strategy document at an EU level to do so.
In order to achieve these goals, the strategy contributes to:

- strengthen existing knowledge of climate change and its impacts;
- assess Italy's vulnerability, along with potential adaptation options for all existing natural and socio-economic systems;
- promote participation,
- increase awareness of stakeholders and encompass adaptation within sectoral policies in a more effective way through improved dialogue and communication;
- strengthen information on adaptation through improved communication regarding potential risks and hazards, as well as potential benefits that may arise from climate change; and
- identify instruments to define the best adaptation options, including potential co-benefits associated with them.

It was the final outcome of a national project, "Elementi per una Strategia Nazionale di Adattamento ai Cambiamenti Climatici" (SNAC) or "Elements to develop a National Adaptation Strategy to Climate Change", funded by IMELS, from 2012 to 2014 and of a collaboration between scientists, stakeholders and decision makers. The scientific/technical coordination of this national project was assigned to the Euro-Mediterranean Center on Climate Change (CMCC). A comprehensive scientific literature review provided an extensive knowledge base on past, present and future climate change and on impacts and vulnerabilities of micro/macro sectors to climate change (water resources; desertification, soil degradation and droughts; hydrogeological risk; biodiversity and ecosystems; health; forestry; agriculture, aquaculture and fishery; energy; coastal zones; tourism; urban settlements; and critical infrastructure). Vulnerability assessments also generated information for two case studies (the mountain areas of the Alps and Apennines, and the Po river basin).

Three main deliverables were accomplished:
1) a Report on the status of scientific knowledge with regards to climate change impacts, vulnerability and adaptation in Italy;

2) an Analysis of the EU Adaptation Strategy and of its implementation in the different sectors of the Italian National Adaptation Strategy;
3) a Strategic Document containing the National Adaptation Strategy for Italy.

The knowledge base produced through this process was further enhanced by an ongoing dialogue on climate change adaptation among national, regional and local institutions.

Two panels were established for this purpose. An 'institutional panel' coordinated by IMELS, involving representatives of relevant institutions (e.g. Ministry of Economic Development, Ministry of Agricultural and Forestry Policies, Ministry of Health) and other institutional stakeholders (e.g. Department of Civil Protection, State-Regions Conference, National Association of Italian Municipalities), and a 'technical panel of experts' coordinated by CMCC, involving about 100 members of the national scientific community (Medri et al., 2013).

Furthermore, a broad public on-line questionnaire and subsequent more targeted interviews were designed and carried out in order to assess the perception of stakeholders about adaptation and contribute to identify national priorities.

This participatory process involving stakeholders at multiple levels was one of the advantages of the adopted approach (mixing top-down and bottom-up perspectives), contributing not only to the provision of information for the development of the Italian NAS but also to raise the awareness for the need of an efficient adaptation planning.

According to the Ministerial Decree formally approving the NAS, the strategy will be reviewed every five years in order to keep up to date with scientific progress and reflect the results of the monitoring processes that it will create.

As part of this process, two new bodies will be established under the auspices of the Ministry for the Environment, Land and Sea:

- a permanent forum that aims to promote citizen information, improve public knowledge of climate issues and improve public participation in decision-making processes; and
- a national observatory, which will establish territorial priorities and monitor the effectiveness of actions taken.

The IMELS is currently working for the implementation of the NAS through the development of the Italian National Adaptation Plan for Climate Change (NAP). The NAP will provide institutional guidance to other ministries, regions, local authorities and technical-scientific background information, for the integration of adaptation within policy processes.

The Climate-Energy General Directorate of IMELS started to develop the NAP in May 2016. The NAP aims to:

- identify adaptation priority actions for the key sectors identified in the SNAC, specifying the timing and the responsible for implementing the actions;
- provide guidelines for improving the exploitation of potential opportunities;
- foster the coordination of actions at different levels.

An on line questionnaire was made available on the IMELS website until February 28, 2017. It was finalized to collect information by key stakeholders, on the perception of the impacts and vulnerabilities related to adaptation and on the necessary actions to implement. The NAP is also being shared with national institutions, regions, and central government.

Despite the NAS has been recently approved and the development of the NAP is currently ongoing, some adaptation initiatives have already been implemented in the context of the existing policies for environment protection, natural hazards prevention, sustainable management of natural resources and health protection.

The most relevant efforts at the national level are acknowledged to be in the domains of human health, agriculture, water resources, coastal areas management, and the fight against desertification. These include specific legislation and other non-binding frameworks such as:

- the ***Italian National Biodiversity Strategy*** launched in 2010 by IMELS for being implemented in the period 2011-2020. The Strategy explicitly aims at reducing substantially the impact of climate change on biodiversity by 2020, by defining appropriate measures of adaptation and mitigation, also targeted at increasing the resilience of natural and semi-natural ecosystems to climate change.
- the ***National Action Programme to Combat Drought and Desertification*** (CIPE, 1999), aimed at reducing losses of soil productivity caused by climatic changes and human activities, in the context of sustainable development, following the ad hoc guidelines elaborated by the National Committee to Combat Desertification (CNLSD). It provides a coherent set of indications useful for the adaptation to climate change and entrusts the Regional Governments and Watershed Authorities with the responsibility to accordingly

develop Local Action Programmes (LAPs) to Combat Drought and Desertification. Currently, 10 Italian Regional Governments adopted their own LAP.

- the White Paper on rural development and climate change titled ***"Challenges and opportunities of rural development for mitigation and adaptation to climate change"*** (Ministry of Agriculture and Forestry, 2011). The White Paper aims at increasing the resilience of the agricultural sector to climate change as well as improving the investments in a low-carbon economy through the development and diffusion of renewable energy and green products.
  - the **National program for the prevention of heat-health effects during summer.** Since 2004, the Italian National Civil Protection and the Ministry of Health have implemented a national program for the prevention of heat-health effects during summer, which to-date includes 34 major cities and 93% of urban residents aged 65 years and over. The national Heat Plan is the only climate change related health adaptation measure operational in Italy. The system includes institutional bodies involved in all the phases of the process.

The NAS has been prepared with a very active stakeholders participation including:

- A questionnaire sent to a large list of stakeholders
- All 3 supporting documents to the NAS have been shared with an Institutional Panel including the relevant ministries, regions, province, municipalities, Civil Protection Agency.
- Three ad hoc workshop held to collect the views of NGOs, regions, provinces and municipalities and private sectors on the draft of the NAS.
- The final draft NAS document underwent an open (with registration) on-line review.

At the sub-national level, a range of remarkable initiatives has been designed and implemented by Regions, Provinces, Cities and Municipalities.
Italy is also active in several international cooperation initiatives on climate change related topics, including transnational cooperation efforts (e.g. in the context of the Alpine Convention) and capacity building activities in developing countries, funded by the Italian Ministry of Foreign Affairs and IMELS.

2.2.2 Science Approaches in relation to CCA

2.2.2.1 *Climate indicators al local scale*

The Italian National Institute for Environmental Protection and Research (ISPRA) has developed a computerized system called SCIA (www.scia.isprambiente.it) in order to optimize the use of instrumental data for climate knowledge and climate change assessments and building a bridge between climate research and societal sectors involved in climate change impacts.
In Italy, the meteorological data necessary and useful for climate evaluations are collected, processed and archived by a wide range of national and regional institutions (the national Air Force weather service, the automatic stations of the national agro-meteorological network, the meteorological stations of the national Sea Service and twelve regional environmental protection and agro-meteorological agencies). These data may be responsible for different types of impact, for the assessment of climate model skill and consequently are also necessary for tuning the adaptation strategies.
The SCIA system is dedicated to the collection, quality control, calculation, regular update and dissemination of climate indicators, which reflect the main statistical properties (mean values, intensity and date of occurrence of extreme events, standard deviation, etc.), at different time scales (i.e. 10-daily, monthly and yearly), of a wide range of meteorological variables: temperature, precipitation, humidity, wind, water balance, evapotranspiration, degree-days, cloud cover, sea level pressure and solar radiation. All climate indicators are freely available through the SCIA web site and since 2006 are used by ISPRA for publishing an annual report on the status and trends of climate in Italy.

2.2.2.2 *Impact and vulnerability assessment*

The impact and vulnerability assessment in relation to CCA is summarized in the "Report on the status of scientific knowledge with regards to climate change impacts, vulnerability and adaptation in Italy" commissioned to CMCC by IMELS. It is essentially consistent with the International Panel on Climate Change (IPCC) and the European Environmental Agency (EEA). It also takes into account some inter-sectoral aspects such as the climate change impacts cost assessment and provides insight on two particularly vulnerable areas: the Alpine area and the Apennines and Po river basin districts.

The Mediterranean region (Southern Europe and non-European Mediterranean countries) which includes Italy has been considered highly vulnerable to climate change (IPCC, 2014).
The whole region is expected to be particularly exposed to negative climate change impacts over the next decades. Such impacts are mainly related to possible exceptional temperature rise, especially in summer, increased frequency of extreme weather events (heat waves, droughts and severe rainfalls) and reduced annual precipitation and river flow (a complete assessment of climate change in the Mediterranean region is contained in Navarra & Tubiana, 2013 and 2013a).

In this context, Italy expects a range of impacts and vulnerabilities associated with climate change that would critically affect the following national circumstances:

- water resources and areas at risk of desertification;
- coastal areas prone to erosion and flooding and susceptible to alterations of marine ecosystems;
- Alpine regions and mountain ecosystems experiencing glacial loss and snow cover loss;
- areas prone to flood and landslide risk (including the risk of flash floods, flash mud/debris flows, rock falls and other mass movements related to soil and land management) and, in particular, the hydrographical basin of the Po.

An overview of the expected climate change impacts and vulnerabilities in Italy, covers the following twelve key sectors identified in the NAS:

- Water resources;
- Areas at risk of desertification, drought and soil degradation;
- Areas at risk of floods and landslides;
- Biodiversity and ecosystems (marine, terrestrial and inland water ecosystems);
- Health;
- Forestry;
- Agriculture, fisheries and aquaculture;
- Energy;
- Coastal zones;
- Tourism;
- Urban areas;
- Critical infrastructure (cultural heritage; transport infrastructure);
- Special case studies (Alps and Apennines; Hydrographical Basin of the Po River).

The sectors were chosen for two main reasons. First, these are the most vulnerable sectors identified through relevant findings in overall scientific assessments on the Mediterranean region and Southern Europe (Navarra & Tubiana, 2013 and 2013a; EEA, 2012, EEA, JRC & WHO, 2008; IPCC, 2015). And second, they include the priority sectors identified by the research community in Italy throughout various national studies (Castellari & Artale, 2009; Carraro, 2008; Menne & Wolf, 2007).
The NAS identifies the Alpine area and the hydrographical basin of the River Po as highly vulnerable sectors due to critical impacts of human activities on environmental ecosystems, landscape and economy.

2.2.2.3 *Multi-stakeholder coordination*

The Ministry of the Environment, mainly in charge for CCA, has established an inter-institutional platform with representatives of relevant Ministries and public institutions involved in CC issues and has entrusted the Euro-Mediterranean Centre on Climate Change (CMCC) with the coordination of a technical board composed by national experts belonging to several universities, research centres and foundations.

2.3 Legal/policy and science approaches combining CCA & DRR

2.3.1 Legal/policy approaches combining CCA/DRR

2.3.1.1 *The National Platform for Disaster Risk Reduction*

In line with Sendai Framework Priority 2, Italy has established its National Platform for the Disaster Risk Reduction, through a Prime Minister's Decree (n. 66/2008). This Platform is intended as the tool at national level to achieve the Italian commitments on risk reduction. It aims at ensuring a coordination of the risk reduction policies among all the represented subjects, e.g. the main stakeholders mentioned in Section 4.1.4. The National Department of Civil Protection (Presidency of the Council of Ministers) with the role of overall coordination.

2.3.1.2 *The National Climate Change Adaptation Plan*

The Italian Ministry for the Environment Land and Sea (IMELS), is currently working for the implementation of the National Climate Change Adaptation Strategy through the development of the National Climate Change Adaptation Plan. The Plan will provide institutional guidance to other ministries, regions, local authorities and technical-scientific background information for the integration of Disaster Risk Management and adaptation within policy processes.

2.3.1.3 *Government program to support climate change adaptation at local level*

For the implementation of the Directive 2003/87/CE, as adopted in Italy with the Legislative Decree n. 30/2013, a "carbon market" for trading CO_2 allowances has been set up. The revenues of the auctions of these units can be used, up to the extent of 50% of the total, to support adaptation to climate change impacts[4]. On this basis, the Ministry of Environment has spent part of the 2013 revenues for the containment of little landslides in mountain cities, caused or worsened by climate change. 17 regions and almost 55 municipalities were involved in this program. This initiative implied the approval of program agreements between the Ministry of Environment and the beneficiary Regional Administration.

2.3.1.4 *Assessment of flood risk and adaptation*

The Legislative Decree 49/2010[5] transposing the EU Floods Directive establishes that Climate change adaptation shall be considered in the development of long-term scenarios for the assessment of flood risk (art. 4, point 2). In some Regions the River Basin Authorities, in charge of the implementation of the Plan for Hydrogeological Risk-Prone Areas (PSAI) have introduced hazards and vulnerability evaluations in relation to local climate change scenarios. In Campania Region, the Central Campania Region River Basin Authority (AdBCC) has released in 2014 the PSAI, updating the previous (2007) version of the plan, and including hazard characterization for different hydrogeological events, including a preliminary definition of local guidelines and standards for the safeguarding and risk mitigation of the territory. The approach is based on the development of supporting tools compatible with models and tools employed by AdBCC, such as the application of the CLIME software (developed by CMCC - Euro-Mediterranean Center for Climate Change) to define 30 years' extreme precipitation simulations in the area, based on alternative RCP scenarios. The integration of these simulations within the urban and building design actions allowed a more comprehensive approach to the mitigation of hydrogeological risk and adaptation to extreme precipitation events, strengthening the connection among climate science, governance policies, and planning/design solutions.

2.3.1.5 *The Budget Law 2017*

The "Budget Law" 2017 represents the most comprehensive effort to integrate DRR and CCA strategies and action at national level from a legal/policy perspective, with the aim of mobilising funds for sectorial actions which are

[4] art. 10, sect. 3 of Directive 2003/87/CE and art. 19, sect. 6, letter a) of legislative decree 30/2013.

[5] "[…] *The preliminary assessment of flood risk provides an assessment of potential risks, mainly on the basis of the recorded data, quick analysis, and studies on long-term developments, including in particular the consequences of climate change on the occurrence of floods and taking into account the flood hazard. The assessment includes at least the following elements: […]. assessment of the potential adverse consequences of future floods on human health, the land, the properties, the environment, the cultural heritage and the economic and social activities, taking into account factors such as, i. topography; ii. location of surface bodies and their general hydrological and geomorphological characteristics; iii. areas of natural expansion of floods; iv. effectiveness of existing man-made flood defense infrastructure; v. location of populated areas, those where there are economic and social activities; vi. long-term scenarios, such as socio-economic and environmental ones, also determined by the effects of climate change […]".*

seen as complementary steps towards the achievement of a more resilient society. A wide range of actions is provided, linked to the framework of Agenda 2030 and Sustainable Development Goals (SDG).
The most relevant measures from an integrated approach to DRR and CCA are the combined tax incentives for seismic and energy/environmental retrofitting (Art. 2) and the CasaItalia program for seismic safety of residential buildings.
The law has introduced new parameters for tax deductions of private investments related to building renovation oriented to seismic strengthening, energy retrofitting and water efficiency. Provided deductions vary depending on the levels of seismic and energy improvement following the renovation.

2.3.1.6 *CasaItalia*

CasaItalia is a preventing and adaptive project launched after the Council of the Minister of 25/08/2016 as a consequence of the massive earthquake of Central Italy (2009 and 2012). The project, promoted also by the Italian architect Renzo Piano, has the aim of reducing buildings vulnerability, ensuring the liveability of places and incrementing community resilience.
The name Casa Italia refers to the core of the project: ensure the safety of domestic places. Different subjects involved in the project have the task of producing risk maps of the whole national territory and buildings data collection, in way of individuate the areas where is necessary and urgent to act.
The different actors involved are:

- Italian National Institute of Statistics (ISTAT);
- Institute for Environmental Protection and Research (ISPRA);
- Italian National Agency for New Technologies Energy and Sustainable Economic Development (ENEA);
- National Research Council (CNR);
- Revenue Agency;
- Ministry of the Environment Land and Sea;
- National Institute of Geophysics and Volcanology.

Specific objects of the projects include to experiment new technologies in the field of architecture and engineering, at the same time ensuring the liveability and the usability of residential buildings; developing guidelines extendable to the whole national territory; involve and aware local actors on safety and risk topics; streamlining and simplifying funding procedures activates by the Government.

2.3.2 Science approaches combining CCA/DRR

2.3.2.1 *Assessment of flood risk and adaptation*

According to the previous Decree 49/2010, Po River Basin Authority is considering, in the current review of flood risk management plans, climate change in the development of long-term scenarios, through:

- update of rainfall datasets, including more recent, high time-resolution(hourly) data series;
- assessment of recent trends of hydrological parameters and potential impacts on flood development;
- development of climate change scenarios with extended time horizon (2050) and identification of possible impacts and adaptation measures.

Other River Basin Authorities (e.g. Arno, Adige, Tiber River Basin) are working in order to update their planning instruments based on the European Directives (2000/60/CE and 2007/60/CE) as well as the Italian law and to take into account climate change scenarios in their assessments.

2.3.2.2 *National Guidelines for the coastal protection: management of coastal dynamics*

In April 2015 the Ministry of Environment established a National Panel on Coastal Erosion (TNEC), with the technical support of ISPRA and the national scientific community and the involvement of all the Italian coastal regions. One of the main objectives of the Panel was the definition of the "National Guidelines for the coastal protection: management of coastal dynamics" presented in November 2016. The Guidelines represent a good opportunity to enhance the joint collaboration of the Mediterranean countries on coastal risks issues and to promote the implementation of macro-regional strategies. For this purpose, the Guidelines take into account climate change scenarios and the adaptation approaches are integrated among the interventions foreseen to cope with the erosion risk. In line with current trends in coastal zone management the Guidelines recommend low impact approaches instead of rigid structures for coastal protection

2.3.2.3 ***National Guidelines for the planning and design of hydrogeological risk reduction interventions***

The Plan for Flooding Protection in Metropolitan areas (Decree Law 133/2014 - Law 164/2014) is a first step for the implementation of the "National Plan 2014-2020 for prevention against hydrogeological risk and for the ordinary maintenance of the territory". The plan for the metropolitan areas include 1.3 billion for intervention of water protection in the 10 metropolitan areas and in special statute regions. The innovation of this plan is its organic structure, where intervention and risk exposure are classified depending on the level of dangerousness and on the number of population exposed, contributing at the selection and funding process of the most relevant interventions.

Italia Sicura is a National program on hydrogeological risk reduction and water infrastructure development and enhancement of scholastic buildings, first started in July 2014 and on the lines of previous programs of interventions on areas affected by natural disasters. For the whole national territory are allocated 9 billion of euro and the municipalities involved are 1.130, including the 40% of the total national population. The program provides different projects throughout Italy for reduce and manage hydrogeological risk exposure of the Country as well as new water infrastructural projects whose completion is monitored on the Italia Sicura Platform.

2.3.2.4 ***Good practices***

The following can be considered as examples of good practices of integration of science and policy in CCA and DRR at different levels:

- **Emilia Romagna Region Adaptation and Risk Management Experiences**
  Emilia-Romagna is one of the largest Italian Regions that for facing extreme events needs to develop adequate mitigation procedures for managing a medium-large river (the Po), with its complex network of small tributaries, which have a torrent-like regime and to protect its sandy beaches with a high level of occupation. To this aim the current Emilia Romagna adaptation strategies are mainly based on 3 pillars:
  - *Prevention: Coastal plan and flood risk management plan according to EU Directive 2007/60; land use* planning policies
  - *Protection:* Maintenance programme for flood defence interventions, Coastal defence maintenance and nourishment.
  - *Preparedness*: Early warning systems and civil protection response, including associated vulnerability mapping, and accurate forecasting of major storms, extra tropical cyclones and medicanes via synoptic weather circulation models and flood forecasting. In particular, the alert system of regional sea storm is a daily operational and allows to predict the potential impacts of a storm on the coast with an advance of about 72 hours.

  In addition to this Emilia Romagna region is starting a process to develop a regional mitigation and adaptation strategy based on the mitigation and adaptation actions included into the sectorial plans. As pilot project the Emilia Romagna has developed the **Cost Adapt project** (Adaptation service for regional assessment of climate risks) with the aims to explore the business perspectives of a consulting service for regional administrations, that will facilitate the climate adaptation pursuits and hence help to significantly reduce the costs of climate change.
- **Venice Adaptation and Risk Management Experiences**
  The climate change effects can increase the hydraulic risk in all the Venice Lagoon area due to the winter rains and the future sea level rise. For this reason, Venice has adopted **The *general plan for the Venice Lagoon conservation*** including several widespread actions that represent examples of urban and environmental resilience and the **MO.S.E. project** (Experimental Electromechanical Module). It is an integrated system consisting of 4 barriers and 78 mobile gates that are able to temporarily isolate the Venetian Lagoon from the sea. It was built at three lagoon inlets to be activated during exceptionally high tides. The defence structure, whose construction started in 2003, is designed to cope with an increase of up to 60 cm in sea level. In addition to the MOSE.
  In addition, a set of local defence interventions to cope with the most frequent flooding and actions aiming at the morphological reclamation of the lagoon for coping with erosion have been developed.
- **Municipality of Ancona - Local Adaptation Plan.** In the framework of the EC LIFE project *ACT - Adapting to climate Change in Time*, the Municipality of Ancona applied a participatory model for the development of its Local Adaptation Plan (LAP) to climate change. The LAP was defined by the Municipality in close collaboration

with the Local Adaptation Board (LAB), consisting of key stakeholders from the most vulnerable areas, as identified by the local climate change impacts assessment carried out within the project.

- **Province of Genova – Adaptation Action Plan.** The Genova Province (Liguria region) implemented a series of initiatives on climate change adaptation under the INTERREG project *GRaBS - GReen and Blue Space adaptation for urban areas and eco towns.* Within this framework advanced methods of planning for new urban settlements, both residential and public, were developed based on the principles and methods of environmental protection. Also, best practices on urban green spaces were defined and a tool for climate change risks and vulnerability assessment of the territory (as a planning support tool to adapt to climate change) was produced.
- **Community resilience in D'Agri Valley: Municipality of Viggiano, Gruppo Lucano and Robert Mallet Foundation.** The Agri Valley is located in Lucania region, a geographical area that includes Basilicata, Southern Campania and North Calabria, with about 70,000 people living in the proximity Agri River Valley.

  Viggiano, important strategic center for oil production and pre-processing and the largest continental oil reservoir in Europe, is part of the UNISDR Making Cities Resilient Campaign since 2012.

  The activities promoted by the Municipality of Viggiano, Gruppo Lucano and Robert Mallet Foundation in Viggiano/Val d'Agri has allowed creating critical mass and social cohesion based on sense of solidarity (volunteering and human capital), community and relation with local institutions.

  The proposed approach is an example of community resilience and organisational capability, which includes:
  - civil protection organisation (DRM)
  - scientific research (DRR+CCA)
  - communication and education

  The current expressed need is to activate specific studies to sensitize decision-makers, so to have access to technical and financial resources to program long-term action for territorial governance and resilience-based planning.

3 Research methodology

Based on a thorough literature review summarised in Sections 1 and 2 and the outcomes of interviews made to key national stakeholders from the science, policy and regulatory domains involved in DRR and CCA reported in Annex, the main findings for the Italian case are reported in Section 4.

The research methodology is based firstly in the selection of the relevant literature at national level, subdivided in the categories “Official reports and Laws” and “Scientific Literature” (see Section 6). The findings from literature have been classified in relation to the document template provided (so to make comparable the different national reports provided within ESPREssO) and discussed in detail to provide a general overview of the current situation in the field of science, policy and regulation for DRR and CCA.

A panel of high-level stakeholders have been selected to participate to the interviews, in relation to the specific field of expertise and institutional role within the national context:

- National Department of Civil Protection (DPC - coord. Daniela Di Bucci): DRR, science, policy and regulation, link with EU policies
- Euro-Mediterranean Centre for Climate Change (CMCC - coord. Sergio Castellari): DRR and CCA, science and policy, link with EU policies
- National Institute of Geophysics and Volcanology (INGV - coord. Augusto Neri): DRR, science
- Senior scientific and political international expert (Franco Barberi): DRR, science, policy and regulation

The interviews have provided a solid grounding to the analysis and findings from the literature review, identifying key topics at national level, observed as recurring issues both in literature and interviews.

In Section 4, analysis and findings are then synthesized from both sources, providing for each paragraph reference to the sources of information (in brackets at the end of each paragraph).

4 Analysis and findings

This section critically reviews the existing legal/policy and science approaches based on key challenges/gaps identified. The analysis and findings are grounded in the literature synthesis and interview findings. The literature synthesis and interview findings are discussed jointly in section 4.

4.1 Challenges/Gaps related to GOVERNANCE in the existing legal/policy and science approaches

4.1.1 Institutional Barriers

- DRR has a long tradition in Italy because of the active role of the National Department of Civil Protection and the reception of the EU Directives (e.g. WFD and Floods), while CCA has been addressed only very recently mainly from Ministry for Environment (with the adoption of the Italian Climate Change National Adaptation Strategy – NAS – and the ongoing work on the National Adaptation Plan – NAP) and in the last decade from the Ministry for Agriculture and Forestry and the Ministry for Health for heat waves (CMCC, 2017).

- As far as the CCA policy is concerned, the Department of Civil Protection has no specific mandate to deal with it. Nevertheless, working on the mitigation of disasters impacts, the National Service of Civil Protection is indirectly involved in CCA: e.g. the National Service of Civil Protection is trying to adapt and enhance the national early warning system in order to better respond to extreme rainfall events (spatially and temporally concentrated), that are increasing in frequency during the last years all over the Italian territory due to climate change effects (DPC, 2017).

- The establishment of Concurring legislation (state/regions) in the field of Civil Protection by the Constitution of the Italian Republic (art. 117) generated a variety of regional laws, in many cases independent from each other, sometimes in contrast (DPC, 2017).

- Some relevant stakeholders in the field of DRR and CCA policies operate on a regional basis (e.g., the Health management). Hence, the limited organic vision of the regulations at national and regional levels also implies a distribution of the accountability that can become a real, confuse fragmentation (DPC, 2017).

- Institutional complexity is intrinsic in the Italian public administration, but also the result of the proliferation of laws affecting the civil protection system (DPC, 2017).

- There is in some cases a limited awareness of Municipalities (the main local authority for Civil Protection in charge of emergency management) of the role of different actors and stakeholders in case of emergency. Bodies such as Provinces (intermediate level between Regions and Municipalities) and Prefecture (state level) have an ambiguous role which sometimes generates confusion in relation to the leading role of Municipalities established by law (literature findings).

- The main challenges for governmental bodies when dealing with DRR and CCA are mostly related to the insufficient awareness of the existing risks as well as the strongly diverse nature of natural and anthropic risks. An additional issue is the lack of personnel in these bodies having a sufficient scientific and technological background able to understand the nature of risks (INGV, 2017).

4.1.2 Funding Arrangements

- The main funding sources for DRR and CCA can be resumed as follows:
  - DRR: Department of Civil Protection (National Seismic Prevention Program), National Government (Italia Sicura, Casa Italia)
  - CCA: Life projects, Regional funds (ERFD, ESF and Cohesion Fund)

- The main support to CCA funding is still at EU level (CMCC, 2017).

- No government structure is officially in charge to deal with CCA. The Ministry of Environment should in principle have prime responsibility, but concrete action to promote CCA are at a very early stage. Therefore, there is no specific funding for CCA (Barberi, 2017).

- Budgetary limits imposed by EU policies to the single countries (e.g. Stability Pact) are a serious obstacle to a coherent implementation of DRR plans (both in terms of prevention and emergency planning). The 2009 and 2016 Italian earthquake crises has shown the consequences of such limitations for the implementation of both reconstruction and prevention measures established by the art. 11 of the Law 77/2009, providing a budget of 980M€ to be spent in 7 years from 2009 (literature findings).

- The financial support provided by DPC to national research institutions and universities covers adequately the scientific monitoring of the territory for earthquakes, volcanic eruptions, landslides and floods, and the related hazard studies. No adequate attention is given instead to the risk assessment, namely to the vulnerability evaluation of exposed goods (Barberi, 2017)

4.1.3 Political will/Motivation

- The evidence that there is a political will to integrate DRR and CCA could be indirectly found in the fact that within the National Platform for DRR and in the CC inter-institutional board, the representation is ensured of the Departments/Ministries/Agencies with competence on the two issues, in order to share information, strategies and to ensure coordination. The National Platform for DRR can be seen as the main challenge to effectively integrate DRR and CCA (DPC, 2017).

- Obstacles to the implementation of effective DRR and CCA integrated policies still lie in the limited political and institutional awareness of the problem. Findings from scientific research and innovative technological approaches hardly find concrete application in governance measures (literature findings).

- A general awareness at all governance level of the need of CCA/DRR integration is still missing, the Italia Sicura programme, recently started, represent an important opportunity in this sense. The NAS has a specific chapter dealing with links between CCA and DRR. At the time of development of the NAS (July 2012- July 2014) the initiative “Italia Sicura” was not yet started. Now at the National level the Italia Sicura initiative, which deals with DRR (landslides and floods) but now also with water resources, represents a challenge for effectively dealing with CCA/DRR integration in Italy (CMCC, 2017).

- In terms of transboundary issues about climate change the NAS does not tackle the transboundary climate change impacts, on the other hand Italy is an active member of the Alpine Convention which address the adaptation in all Alpine region (CMCC, 2017).

4.1.4 Stakeholder complexity

- The main legal/policy Italian stakeholders in the field of DRR and CCA can be resumed as follows:
    - National Department of Civil Protection - Presidency of the Council of Ministers (main responsible for DRR)
    - Ministry of the Environment and Protection of Land and Sea (main responsible for CCA)
    - Department for the Regional Affairs, Local Governments and Sport - Presidency of the Council of Ministers
    - Ministry of Foreign Affairs and International Cooperation
    - Ministry of Interior
    - Ministry of Defence
    - Ministry of Economy and Finance
    - Ministry of Economic Development
    - Ministry of Infrastructure and Transport
    - Ministry of Health
    - Ministry of Education, Universities and Research
    - Representatives of the Regions
    - Representatives of the Provinces
    - Representatives of the Municipalities
    - The Italian Council of the Associations of Civil Protection Volunteers

- Other institutions identified by the Head of the Department of Civil Protection within the National Service of Civil Protection.

- Their responsibilities are established through laws, regulations, standards and procedures. Each of the abovementioned entities can decide to involve further stakeholders (e.g., representatives of the telecommunication industry, energy companies, research institutes, etc.). The effective coordination of such a complex network of stakeholders represents a key challenge in DRR and CCA law/policy implementation (literature findings).

- In relation to CCA, the NAS adoption decree (June 2015) endorsed the establishment of a Permanent Forum. This body could be key in order to improve the interaction with the Italian stakeholders (CMCC, 2017).

4.1.5 Procedural Gaps and Legal Frameworks

- Law 100/2012 imposes limitations to the National Department of Civil Protection for what concern the expenses cap and the duration of the "state of emergency". The latter, which allows to adopt simplified procedures in the assignment of tenders for emergency operations (e.g. rumble clean-up, provisional protections, etc.), is limited to 180 days, which often is not enough to complete all the needed actions. At the same time such limitations prevent delays and should streamline the procedures improving the effectiveness of Civil Protection actions in the post-event phase (literature findings).

- Different type of emergency should entail different duration of the "state of emergency" phase (e.g. a small earthquake is very different from a very strong one, and a major flood is very different from an exceptional volcanic eruption). This is still indeed a delicate and controversial issue to be addressed in the next regulatory improvements (literature findings).

- Regulation gaps are observed in relation to the accountability/liability both in terms of Civil Protection decisions (e.g. false alarms or management errors), both in terms of professional liability in prevention actions (e.g. structural retrofitting of buildings and infrastructures) and emergency technical operations (e.g. post-event safety checks) (literature findings).

- The Italian civil protection system has been challenged during the L'Aquila trial, where the complexities of the science-justice relationship clearly emerged. There is certainly the need to update the legal and policy support to the development of science innovation (INGV, 2017).

- Transboundary issues need to be faced through the establishment of cross-boundary authorities based on the different risks. E.g. seismic risk prevention and emergency management should be managed by interregional authorities involving more Italian regions (e.g. in the Apennine ridge) or neighboring countries (e.g. Western Alps), while volcanic risk should be managed by international authorities (e.g. Vesuvius or Campi Flegrei eruption entails potential physical impacts in the Balcan region, and involves Europe as a whole in terms of emergency management). The challenge is to build-up common transboundary models and procedures to increase the effectiveness of a coordinated action in the field of the technical management of emergency, safety evaluation and risk prevention (literature findings).

4.1.6 Mismatches

- A significant mismatch is observed concerning the competences established by law for the different local authorities in the preparation of Civil Protection Emergency Plans. The Regions are provided with adequate funding, but their role is limited to provide general addresses and guidelines. Provinces (Metropolitan Cities) and Municipalities are in charge of producing the plans, but do not have adequate resources (literature findings).

- In the case of CCA different entities, not always interacting, follow different approaches (DRR started in Italy only recently to consider the use of climate scenarios to develop and implement their measures) and different source of funding (CMCC, 2017).

- DRR and CCA communities in Italy show a different knowledge base and different approach and terminology (CMCC, 2017).

4.2 Challenges/gaps related to RISK in the existing legal/policy and science approaches

4.2.1 Risk Perception

- The results of surveys carried out in risk-prone areas show that in many cases common people do not even know the risks their community is exposed to, and at which level (for instance, on volcanic and seismic risk perception in Italy, see Barberi, 2008; Crescimbene, 2008; Crescimbene et al., 2014). In relation to the role of existing legal/policy frameworks in influencing the perception of risk among the communities several studies from very different perspectives exist (e.g. Dolce and Di Bucci, 2014; Scolobig, 2015), especially in analysing the relation between risk perception, scientific/legal responsibility and public communication following the L'Aquila case (literature findings and DPC, 2017).

- L'Aquila trial highlighted the evident gaps between the definition of risk from the scientific, technical, legal, policy and general public perspectives. For instance, concerning possible bias in the legal interpretation, Rocco Blaiotta, Judge of the Supreme Court of Cassation, introduces the idea of allowed risk: "The idea of allowed risk [...]: it is difficult to establish the equilibrium point, the boundary between licit and illicit [...] the referee who establishes the boundary between licit and illicit is precisely the judge". And Renato Bricchetti, President of the Court of Lecco, states: "I realize [...] that most of the people feel the need to find a responsible, I don't want to say a scapegoat, but to know who has to be blamed for what happened. And the mass media world amplifies this demand for justice" (DPC, 2017).

- The choice of the definition to be adopted for a given risk can affect the outcome of policy debates, the allocation of funds for risk mitigation and, ultimately, how the political power is distributed within a society (DPC, 2017).

- A more comprehensive definition of risk should also include some psychological and social aspects (DPC, 2017).

4.2.2 Risk Assessment

- Risk assessment and prevention actions in Italy have progressed rather slowly along the years. For instance, only in 1984 a seismic hazard map was approved for the Italian territory and hazard maps for landslides, floods, volcanic eruptions, tsunamis, are incomplete at national level and often not sufficiently precise at local level. Vulnerability studies are still largely incomplete and therefore risk maps are lacking or inadequate (Barberi, 2017).

- Emergency plans are based on hazard and not on risk (i.e. they often do not take into adequate consideration vulnerability and exposure), and therefore they may fail dramatically (Barberi, 2017).

- Research on DRR is mostly sustained by DPC, but it privileges hazard rather than risk studies (Barberi, 2017).

- DRR and CCA should be integrated based on common risk assessment approaches. Climate change effects on disaster risk should be carefully studied, giving particular attention to the phenomena that may be more severely affected by CC considering the geomorphology of the Italian territory, such as sea invasion on flat coasts and slope sliding hazards increased by heavy rains in mountain lands (Barberi, 2017).

- Risk scenarios in the short, medium and long term should be revised in light of expected climate change (Barberi, 2017).

- In relation to the need of harmonising DRR and CCA approaches in the field of risk assessment, there is still an open debate on the different possible methodologies: hazards and risks vs. event and impact scenarios, probabilistic vs. deterministic approach, quantitative vs. qualitative description of the observed phenomenon.

Moreover, the two communities have different technical jargons, and in some cases the same term has different meanings. There is still a long way to be run, but the DRR and CCA communities have recently started a common experience (DPC, 2017).

- In relation to climate risks, the lack so far of a consistent approach to evaluate the risk in the different sectors by using the same climate scenarios and then the specific impact assessment models to estimate vulnerability and then risk (CMCC, 2017).

- The use of specific risk assessment analyses by decision makers highlight three key challenges to be tackled:
  - data availability and completeness at the needed scale, along with their reliability.
  - need to use a shared approach, that is a necessary pre-condition also to address the multi-hazard risk issue.
  - involvement itself of a scientific community as wider as possible

  The challenges above are related to the ways to involve a wide scientific community, in the respect of the scientific method, to achieve consensus on a risk assessment on which the decision-maker has to ground his choices and actions (DPC, 2017).

- One of the main issues which influence the risk assessment is related to the decision concerning the acceptable level of risk (e.g. the reference hazard intensity at the base of emergency planning and land use regulations in a given area) to which refer the consequent political decisions and the following policies (DPC, 2017). The scientific results can support such decision, which however should stay in charge of the political authority (literature findings), while political decision-makers prefer to transfer to scientists and consultants the responsibility of resolving a debate that is however essentially political (DPC, 2017). The current regulation does not identify responsibility and liability in emergency situation, neither for scientists in charge of risk assessment, nor for technicians involved in field surveys and analyses (literature findings).

- The difficulty to decide on the acceptable level of risk makes the implementation of risk mitigation policies very complex, because the Authorities in charge are left in a frame of substantial uncertainty, where making decisions and taking on responsibilities is not simple (and often worrisome). Under these conditions, taking into account the legal implications above outlined, scientists and technical decision-makers may foster a risk assessment that is done considering only the maximum intensity events in spite of the probabilistic approach usually adopted worldwide for the related hazard assessment, neither considering the consequences of this choice in terms of feasibility, nor performing any cost/benefit analysis (DPC, 2017).

- The lacking of a general consensus about the scientific approaches to be put in place for the implementation of effective DRR and CCA strategies can lead to potentially ineffective allocation of funding. The OP Governance and Institutional Capacity 2014-2020 (10M€), as an example, concerning the mitigation of seismic and volcanic risk limits the activities to the seismic microzonation and a partial critical emergency factors analysis, focused only on some systemic components (literature findings).

- The assessment of risk is still in its infancy (worldwide) from many points of view. A key difficulty is to integrate the hazard assessment, vulnerability and exposure information in a common and holistic analysis (INGV, 2017).

4.3 Challenges/Gaps related to SCIENTIFIC FRAMEWORKS in the existing science approaches

- In Italy, some research institutes that provide scientific support to the Ministry of the Environment are also Competence Centres of the National Department of Civil Protection: for instance, this is the case of ISPRA (the Italian National Institute for Environmental Protection and Research). Therefore, concerning the scientific issues, on the one hand there is a good degree of circulation of ideas, of information on activities, and some attempts of coordination and collaboration have been carried out, sometimes with good results. On the other hand, however, the limited availability of funds which characterizes this period is itself a driver of competition between communities (DPC, 2017).

- Some first step aimed to implement best practices in the legal/policy framework but there is a long way ahead (INGV, 2017).
- To integrate and compare different risks, also in the perspective of a multi-hazard risk approach, it is fundamental to use the same metrics to measure the different parameters which describe each risks. This issue, promoted by the Sendai Framework for Disaster Risk Reduction through the "national indicators of disaster risk reduction", is in Italy is still ongoing (DPC, 2017).

- The need for shared metrics should be always suggested and promoted, and this scientific challenge also implies a contribution of interaction and discussion within and between the CCA and DRR communities, involving the related stakeholders and decision-makers (DPC, 2017).

- Interdisciplinarity and multidisciplinarity are key factors to develop an accurate and robust risk assessment. Unfortunately, the good practices using these approaches are still quite rare (INGV, 2017).

- A common strategic and design/technology vision aimed at promoting an integrated approach to DRR and CCA is currently missing at policy level, and found only in some scientific studies (literature review).

- "Italia Sicura" can be a challenging framework to test synergies and interdisciplinary approaches, also aimed at overcoming the different knowledge base and different approach and terminology in DRR and CCA (CMCC, 2017).

4.4 Challenges/Gaps related to COMMUNICATION in the existing legal/policy aspects

- There is a great need for an effective collaboration between technical decision makers of civil protection and the media. It can determine advantages and, in the meanwhile, could reduce some of the problems, mostly induced by the need that media have to increase their audience for commercial purposes, or to support some political orientations (DPC, 2017).

- It is almost impossible to establish a direct and unique link between the original message and the effects on the audience's mind due to the complex process leading to those effects. It is of paramount importance to account for this complexity in the communication of civil protection issues, if definite effects are expected or wanted (DPC, 2017).

- Many differences and barriers exist in terms of language or communication between CCA and DRR communities, academic community and practitioners (theory vs practice), practitioners and general public, national and transboundary levels, mainly depending on the scientific background, education, country, past experience (INGV, 2017).

- Dissemination of best practices in terms of DRR, CCA and transboundary crisis management exist, but much more would be useful and needed (INGV, 2017).

4.5 Any other Challenges/Gaps in the existing legal/policy and science approaches pertaining to the key ESPREssO Challenges

- An institutional program in Professional training schools aimed at the education in the field of DRR is missing (literature findings).

- There is a growing need of improving in Italy the university curricula to deal with CCA/DRR integration (CMCC, 2017).

- There is a need for a stronger effort to integrate the different communities involved is needed also through the framework of coordination and planning initiatives (INGV, 2017).

- Structural interventions aimed at risk prevention are few and inadequate to the necessities (Barberi, 2017).

- Safety monitoring and risk prevention policies (especially on strategic buildings, such as schools and hospitals) should be consistent, binding the vulnerability assessment to the provision of funding for risk reduction (literature findings).

- Integration of DRR and CCA should be sustained at EU level to be effectively transferred to the Italian context (literature findings). In this sense, even considering its specificity, it should be considered the possibility that CCA be directly dealt by an agency of the European Commission in charge of transferring results, estimations, predictions to the structure of the member states dealing with DRR (Barberi, 2017).

5 Conclusions & recommendations

The Italian case represents a valuable example of the complex issues related to three ESPREssO challenges. The high risk proneness of the territory to many natural (geophysical and climate related) and man-made (industrial, technological and natech) hazards and the vulnerability of the territory from both the side of settlements and population exposure (including specific heritage-related and socio-economic issues) and the fragility of the natural ecosystem emphasize the need of improving the scientific, policy and regulatory effort in the field of DRR and CCA, tackling both the risk prevention and emergency preparedness at national level, both the specific issues related to subnational and international boundaries.

Figure 17. Natural and man-made hazards in Italy: "well-known" and "almost unknown" cases.

The variety of hazards and risk conditions in Italy can be generally summarised in two macro-categories, characterized by a different "challenges" in terms of scientific, policy and regulation improvement, opportunity for DRR and CCA synergies exploitation and transboundary cooperation enforcement.

- **"Well-known" cases** (e.g. volcanic eruption at Vesuvius, industrial accident at Seveso, earthquakes in L'Aquila/Centre Italy): Characterized by documented **huge impacts** and **attention from scientists and decision-makers**, around which a **consistent legal framework, research background** and **supporting tools development** has been implemented in the last decades.
- **"Almost unknown" cases** (e.g. Natech in Val d'Agri, droughts in south Italy): Whose actual/potential **impacts are underestimated**, around which **significant community resilience experiences** have been built, **not only at local level**.

Based on the analysis and findings outlined in Section 4, the main issues emerging from the Italian case study, and their relation with ESPREssO challenges, can be resumed as follows:

Science/Legal/policy interface

- Concurring legislation (state/regions) of Civil Protection generated a variety of regional laws, sometimes inn contrast
- Complexity as a result of the proliferation of laws affecting the civil protection system

- Limited awareness of Municipalities about their role in case of emergency
- A significant mismatch is observed by law for the different local authorities: Regions are provided with adequate funding but limited to provide general addresses and Municipalities are in charge of producing the plans without adequate resources
- Law 100/2012 imposes limitations to the National Department of Civil Protection for what concern the expenses cap and the duration of the "state of emergency"
- Regulation gaps are observed in relation to the accountability/liability both in terms of Civil Protection decisions, both in terms of professional liability
- During the L'Aquila trial the complexities of the science-justice relationship clearly emerged
- L'Aquila trial highlighted the evident gaps between the definition of risk from the scientific, technical, legal, policy and general public perspectives
- Specific risk assessment analyses by data availability and completeness need to use a shared approach, involvement itself of a scientific approach
- The current regulation does not identify responsibility and liability in emergency situations
- The difficulty to decide on the acceptable level of risk makes the implementation of risk mitigation policies very complex
- The assessment of risk is still in its infancy (worldwide); a Key difficulty is to integrate the hazard assessment, vulnerability and exposure information in a common and holistic analysis
- The choice of a definition to be adopted for a given risk can affect the outcome of policy debates and it should also include some psychological and social aspects
- Interdisciplinarity and multidisciplinarity are key factors to develop an accurate and robust risk assessment. Unfortunately, are still quite rare
- Common people do not even know the risks their community in exposed to and at which level
- There is a great need for an effective collaboration between technical decision makers of civil protection and the media
- It is almost impossible to establish a direct and unique link between message and the effects on the audience's mind
- No government structure is officially in charge to deal with CCA, therefore there are no specific funding measures
- An institutional program in Professional training schools aimed at the education in the field of DRR is missing
- No adequate attention is given instead to the risk assessment, namely to the vulnerability evaluation of exposed goods
- Emergency plans are based on hazard and not on risk and therefore they may fail dramatically
- Research on DRR is mostly sustained by DPC, but it privileges hazard rather than risk studies
- Structural interventions aimed at risk prevention are few and inadequate to the necessities

Integrated approach to DRR and CCA

- In Italy CCA has been addressed only very recently
- The Department of Civil Protection has no specific mandate to deal with CCA
- The main legal/policy Italian stakeholders in the field of DRR CAA are many (more than 15) and the effective coordination of such a complex network represent a key challenge in DRR and CCA law/policy implementation
- Obstacles to the implementation of effective DRR and CAA integrated policies due to limited political and institutional awareness
- Insufficient awareness of existing risks and lack of personnel dealing with DDR and CCA in the governmental bodies
- Budgetary limits imposed by EU policies to the single countries are a serious obstacle
- Need of harmonising DRR and CCA approaches in the field of risk assessment (methodologies, technical jargons, different meanings)
- The lacking of a general consensus about the scientific approaches to be put in place for the implementation of effective DRR and CCA strategies can lead to potentially ineffective funding mechanisms
- DRR and CCA should be integrated based on common risk assessment approaches

- Risk scenarios in the short, medium and long term should be revised in light of expected climate change
- The limited availability of funds which characterizes this period is itself a driver of a competition between DRR and CCA communities
- The national platform for DRR and Italia Sicura initiative can be seen as the main opportunities to effectively test synergies and interdisciplinary approaches in DRR and CAA
- There is a growing need of improving in Italy the university curricula to deal with CCA/DRR integration
- A common strategic and design/technology vision aimed at promoting an integrated approach to DRR and CCA is currently missing at policy level, and found only in some scientific studies
- Integration of DRR and CCA should be sustained at EU level and should be considered the possibility that CCA be directly dealt by an agency of European Commission in charge of transferring results to the structures of the member states dealing with DRR.

National regulation and transboundary issues

- The National Adaptation Strategy does not tackle the transboundary climate change impacts
- Transboundary issues need to be faced through the establishment of cross-boundary authorities based on the different risk
- Dissemination of best practices in transboundary crisis management exist, but much more would be useful and needed

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7 Explanatory notes

This section provides a brief guidance to understand certain challenges/gaps and its scope.

- Institutional arrangements – means the existing government structures to deal with disaster management
- Institutional Barriers – Means the institutional structure/setting which prevent successful integration of different institutions. E.g. communication,
- Funding arrangements – means the availability of funding
- Non-traditional partnerships – means new partnerships among, local communities, government authorities, schools, NGOs, faith groups etc.
- Temporal scale mismatches - means the difference in timing of CCA and DRR initiatives
- Functional scale mismatches – means the difference among respective authorities/ institutions in terms of functions
- Spatial scale mismatches– means the difference in geographical scale of coverage E.g. locally, nationally, globally
- Knowledge mismatches – means that there are no clear boundaries of knowledge among each communities
- Political will – means the support from the political system
- Stakeholder complexity – means the issues encountered with increasing number of stakeholders
- Procedural gaps – means the differences among procedures, legal requirements when dealing with transboundary crisis in nation states
- Legal frameworks – means the existing legislative mechanisms that govern CCA and DRR
- The epistemological gap: means the understanding of risk among different stakeholders
- Interdisciplinarity – means the way in which the decision making is done across different disciplines

Annexture 02

Synthesis Report on Disaster Risk Reduction and Climate Change Adaptation in Germany

Bonn, Germany | April 2017

Prepared By:

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List of Abbreviations

AA	Department for Foreign Affairs (German: Auswärtiges Amt)
AFK	Permanent Committee on Adaptation to the Consequences of Climate Change (German: Ständiger Ausschuss zur Anpassung an die Folgen des Klimawandels)
AGBF	Working Group of the Managers of the Professional Fire Brigades (German: Arbeitsgemeinschaft der Leiter der Berufsfeuerwehren)
AKNZ	Academy for Crisis Management, Emergency Planning and Civil Protection (German: Akademie für Krisenmanagment , Notfallplanung und Zivilschutz)
APA	Adaptation Action Plan (German: Aktionsplan Anpassung)
ASB	Workers' Samaritan Federation Germany (German: Arbeiter-Samariter-Bund)
AWI	Alfred Wegener Institute for Polar and Marine Research (German: Alfred Wegener Insitut für Polar- und Meeresforschung)
BauGB	Federal Building Code (German: Baugesetzbuch)
BASt	Federal Highway Research Institute (German: Bundesanstalt für Straßenwesen)
BBK	Federal Office of Civil Protection and Disaster Assistance (German: Bundesamt für Bevölkerungsschutz und Katastrophenhilfe)
BBR	Federal Office for Building and Regional Planning (German: Bundesinstitut für Bauwesen und Raumordnung)
BBSR	Federal Institute for Research on Building, Urban Affairs and Spatial Development within BBR (German: Bundesinstitut für Bau-, Stadt- und Raumforschung im Bundesamt für Bauwesen und Raumordnung)
BfG	German Federal Institute of Hydrology (German: Bundesanstalt für Gewässerkunde)
BLAG	KliNa Federal Government's and Federal States' Working Group on Climate, Energy, Mobility and Sustainability (German: Bund-Länder- Arbeitsgemeinschaft Klima, Energie, Mobilität und Nachhaltigkeit)
BMBF	Federal Ministry of Education and Research (German: Bundesministerium für Bildung und Forschung)
BMI	Federal Ministry of the Interior (German: Bundesministerium des Innern)
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (German: Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit) (until 2013: BMU)
BMVBS	Federal Ministry of Transport, Building and Urban Development (until 2013, presently: BMVI) (German: Bundesministerium für Verkehr, Bau und Stadtentwicklung)
BMVI	Federal Ministry of Transport and Digital Infrastructure (German: Bundesministerium für Verkehr und Digitale Infrastruktur)
BMZ	Federal Ministry for Economic Coorperation and Development (German: Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung)
BOS	Emergency and Rescue Services (German: Behörden und Organisationen mit Sicherheitsaufgaben)

CCA	Climate Change Adaptation (German: Anpassung an den Klimawandel)
CIP	Critical Infrastructure Protection (German: Schutz kritischer Infrastrukturen)
CPM	European Civil Protection Mechanism (German: EU Katastrophenschutzverfahren)
CSC	Climate Service Center
DAAD	German Academic Exchange Service (German: Deutscher Akademischer Austauschdienst)
DAS	German Adaptation Strategy (German: Deutsche Anpassungsstrategie)
DFG	German Research Foundation (German: Deutsche Forschungsgemeinschaft)
DFV	Union of the German Fire Departments (German: Deutscher Feuerwehrverband)
DKD	Deutscher Klimadienst
DKK e.V.	German Climate Consortium (German: Deutsches Klima Konsortium)
DKKV	German Committee for Disaster Reduction (German: Deutsches Komitee Katastrophenvorsorge e.V.)
DKRZ	German Climate Computing Centre (German: Deutsches Klimarechenzentrum)
DLR	German Aerospace Centre (German: Deutsches Zentrum für Luft- und Raumfahrt)
DLRG	German Lifeguard Association (German: Deutsche Lebens-Rettungs-Gesellschaft e.V.)
DRK	Red Cross Germany (German: Deutsches Rotes Kreuz)
DRR	Disaster Risk Reduction (German: Katastrophenvorsorge)
DST	Association of German Cities (German: Deutscher Städtetag)
DWD	German National Meteorological Service (German: Deutscher Wetterdienst)
ERCC	Emergency Response Coordination Centre (German: Zentrum für die Koordination des Notfallschutzes)
EU	European Union
ExWoSt	Experimental Housing and Urban Development (German: Experimenteller Wohnungs- und Städtebau)
FONA	Research for Sustainable Development (German: Forschung für Nachhaltige Entwicklung)
FZ Jülich	Jülich Research Centre (German: Forschungszentrum Jülich)
GDV	German Insurance Association (German: Gesamtverband der Deutschen Versicherungswirtschaft)
GEOMAR	Helmholtz Centre for Oceanresearch Kiel (German: Helmholtz-Zentrum für Ozeanforschung Kiel)
GERICS	Climate Services Center Germany (German: Deutsches Klima Service Zentrum)
GFZ	German Research Centre for Geosciences (German: Deutsches GeoForschungsZentrum)
GG	Basic Constitutional Law of the Federal Republic of Germany (German: Grundgesetz)
GMLZ	Joint Information and Situation Centre of the Federal Government and Länder (German: Gemeinsames Melde- und Lagezentrum von Bund und Ländern)
HeRZ	Hans Ertel Centre for Weather Research (German: Hans Ertel- Zentrum für Wetterforschung)
HFA	Hyogo Framework Action (German: Hyogo-Rahmenaktionsprogramm)
HGF	Helmholtz Association (German: Helmholtz-Gemeinschaft Deutscher Forschungszentren)
HZG	Helmholtz Centre Geesthacht, Centre for Materials and Coastal Research (German: Helmholtz-Zentrum Geesthacht, Zentrum für Material- und Küstenforschung)

IDNDR	International Decade for Natural Disaster Reduction (German: Dekade zur Reduzierung von Naturkatastrophen)
IMA Anpassung	Interministerial Working Group on Adaptation to Climate Change (German: Interministerielle Arbeitsgruppe Anpassungsstrategie)
IMK	Conference of Interior Minister (German: Innenministerkonferenz)
IntMinKoGr	Interministerial (Crisis Management) Coordination Group (German: Interministerielle Koordinierungsgruppe des Bundes und der Länder)
IPCC	Intergovernmental Panel on Climate Change (German: Weltklimarat)
JHU	Hospitaller Emergency Service (German: Johanniter Hilfsdienst)
KAS	Commission on Process Safety (German: Kommission für Anlagensicherheit)
KaVoMa	Master of Disaster Management and Risk Governance (German: Masterstudiengang Katastrophenvorsorge und Katastrophenmanagment)
KFS	Disaster Research Unit (Katastrophenforschungsstelle)
KIT	Karlsruhe Institute of Technology (German: Karlsruher Institut für Technologie)
KlimaMORO	Spatial Development Strategies to the Climate Change (German: Raumentwicklungsstrategien zum Klimawandel)
KLIMZUG	Climate Change within Regions (German: Klimawandel in Regionen zukunftsfähig gestalten)
KLIWA	Climate Change and Consequences for Water Management, cooperative project between Rhineland-Palatinate, Baden-Württemberg, Bavaria (German: Klimaveränderung und Konsequenzen für die Wasserwirtschaft)
KLIWAS	Impacts of Climate Change on Waterways and Navigation (German: Auswirkungen des Klimawandels auf Wasserstraßen und Schifffahrt)
KomPass	Competence Centre for Climate Impacts and Adaptation (German: Kompetenzzentrum Klimafolgen und Anpassung)
KRITIS	Critical Infrastructures (German: Critical Infrastructures)
LÜKEX	Transnational Crisis Management Exercise (German: Länderübergreifende Krisenmanagement Übung
MHP	Auxiliary Service of the Order of Malta (German: Malteser Hilfsdienst)
MunichRE	Munich Reinsurance Company Incorporated Company
NATO	North Atlantic Treaty Organization (German: Organisation des Nordatlantikvertrags)
NPSI	National Plan for Information Infrastructure Protection (German: Nationaler Plan zum Schutz der Informationsstrukturen)
PIK	Potsdam Institute for Climate Impact Research (German: Potsdam-Institut für Klimafolgenforschung)
PPP	Public Private Partnership (German: Öffentlich-Private Partnerschaft)
ROG	Federal Regional Planning Act (German: Raumordnungsgesetz)
StA AFK	Standing Committee for the Adaptation to Climate Change Impacts (German: Ständiger Ausschuss zur Anpassung an die Folgen des Klimawandels)
SFDRR	Sendai Framework on Disaster Risk Reduction (German: Sendai Rahmen zur Reduzierung von Katastrophenrisiko
THW	Federal Agency for Technical Relief (German: Bundesanstalt Technisches Hilfswerk)

TRAS	Technical Rules on Installation Safety (German: Technische Regeln für Anlagensicherheit)
UBA	Federal Environmental Agency (German: Umweltbundesamt)
UFZ	Helmholtz Centre for Environmental Research, Leipzig (German: Helmholtz-Zentrum für Umweltforschung)
UMK	Conference of Environment Ministers (German: Umweltministerkonferenz)
UNFCCC	United Nations Framework Convention on Climate Change (German: Klimarahmenkonvention der Vereinten Nationen)
UNISDR	United Nations Office for Disaster Risk Reduction (German: Sekretariat der Vereinten Nationen für Risikominderung)
VOST	Virtual Operation Support Teams
WFD	Water Framework Directive (German: Wasser-Rahmenrichtlinie)
WHG	Federal Water Act (German: Wasserhaushaltsgesetz)
ZSKG	Federal Protection and Disaster Assistance Act (German: Zivilschutz und Katastrophenhilfegesetz)

List of Figures

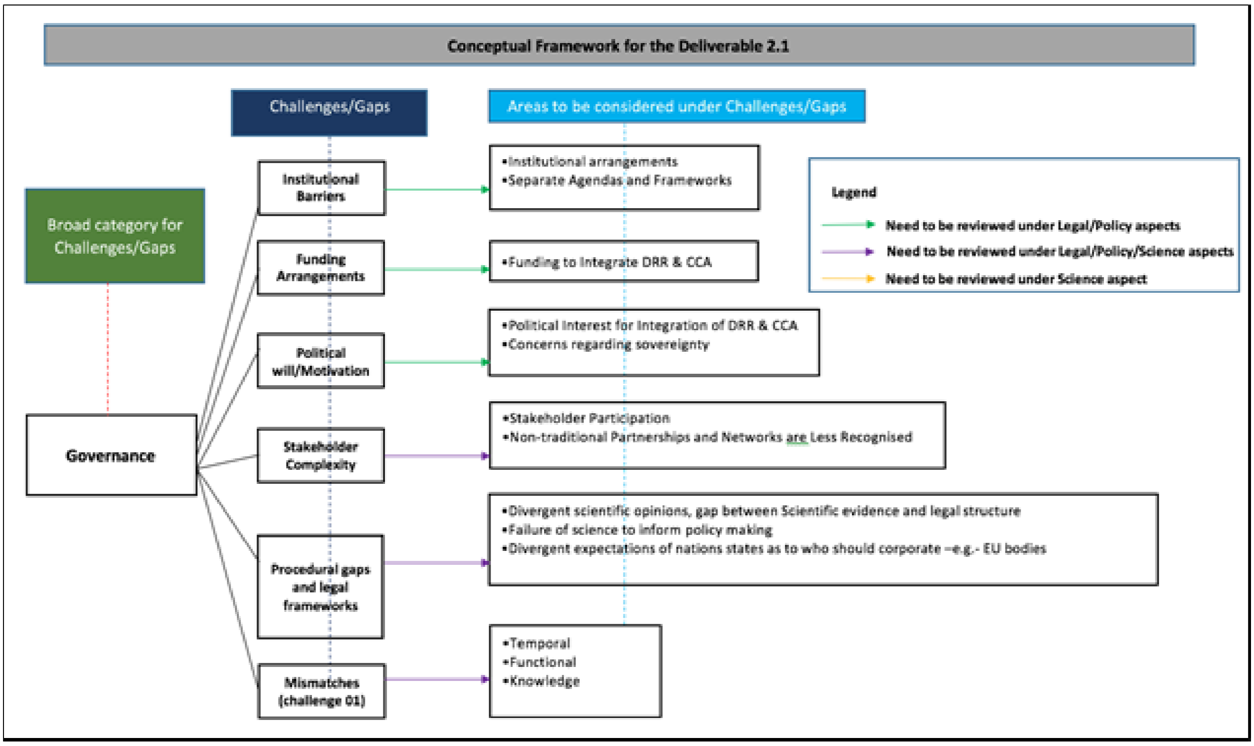
Introduction

This report is part of a larger synthesis to a) collect data across six EU countries and produce reports on the specific national approaches regarding policies, legislation and science frameworks addressing natural hazards and climate change adaptation within the framework of the project “Enhancing Synergies for disaster PRevention in the EurOpean Union” (ESPREssO). These national reports will feed into a synthesis of such approaches both across the EU and globally.

In order to guarantee a comprehensive approach that allows for consolidating the data from national reports, a conceptual framework was developed based on a literature review regarding the project's three main challenges:

1. To propose ways to create more coherent national and European approaches on Disaster Risk Reduction, Climate Change Adaptation and resilience strengthening;
2. To enhance risk management capabilities by bridging the gap between science and legal/policy issues at local and national levels in six European countries;
3. To address the issue of efficient management of transboundary crises.

The key areas identified within the framework support the analysis of potential issues and gaps within the three mentioned challenges. The identified categories were governance, risk, scientific frameworks and communication. Within each category, potential gaps and challenges were proposed to guide the data collection and analysis (see ***Figure 18:*** *Conceptual Framework***Errore. L'origine riferimento non è stata trovata.**) for this report on Germany, whose hazard profile is presented in the next section.



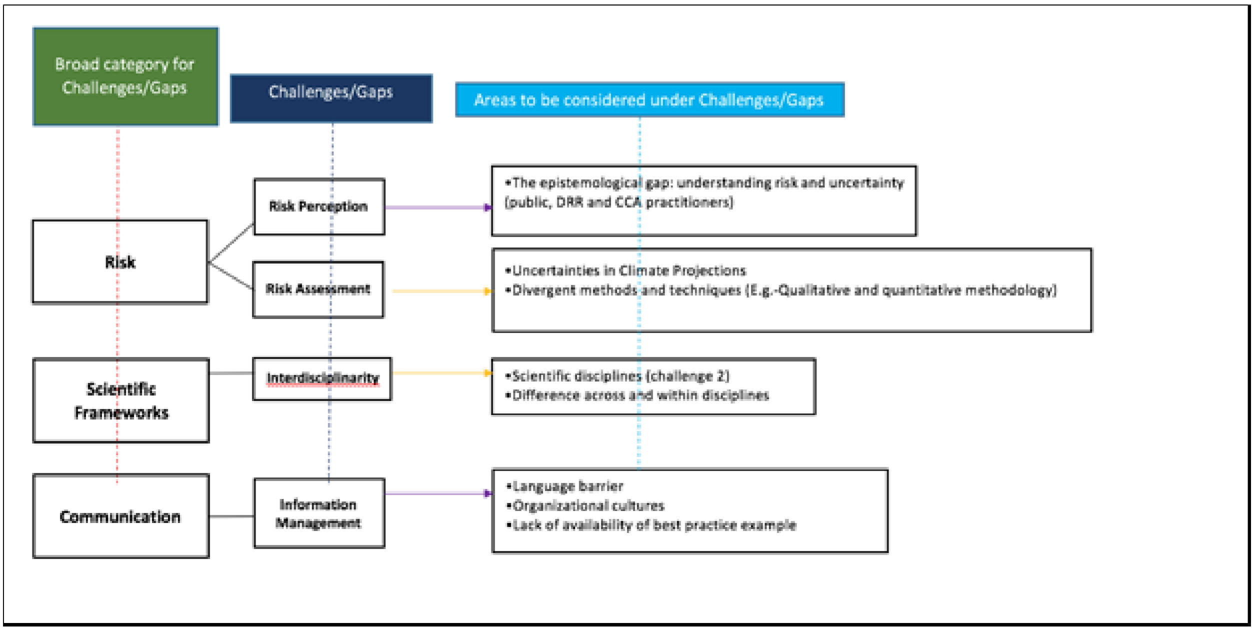


Figure 18: Conceptual Framework

Chapter 2 further elaborates the research methodology, Chapter 3 is the descriptive part of the report, summarizing the status quo regarding institutions and procedures in relation to DRR and CCA and the three ESPREssO challenges in Germany. Chapter 4 then presents the analysis and findings of challenges and gaps within these areas. Finally, chapter 5 outlines conclusions and recommendations to address these challenges.

Natural hazards in Germany

Compared to many countries in the world, Germany is not heavily affected by natural disasters. Nonetheless, this does not mean that it is free from the adverse impacts of such events. Since Germany has no national disaster loss database, statistics on disaster frequencies and impacts are rare and have to be retrieved, e.g. from the global and publicly accessible database EM-DAT[6], in which, however, biases of recording might occur due to certain entry thresholds, temporal changes in the coverage due to increasing media reports on disasters or political changes etc. (see Gall et al., 2009). For Germany, 94 natural events have been recorded in EM-DAT between 1900 and 2016, whereof 73 events have occurred since 1990, indicating a temporal bias (at least for the period before 1990). Figure 2 (left) reveals that the main hazards that have affected the country are storms (winter and summer), floods and extreme temperatures, particularly cold waves, while heat waves, earthquakes, epidemics, avalanches and wild fires occur occasionally. This picture changes dramatically when it comes to disaster impacts.

6 www.em-dat.be

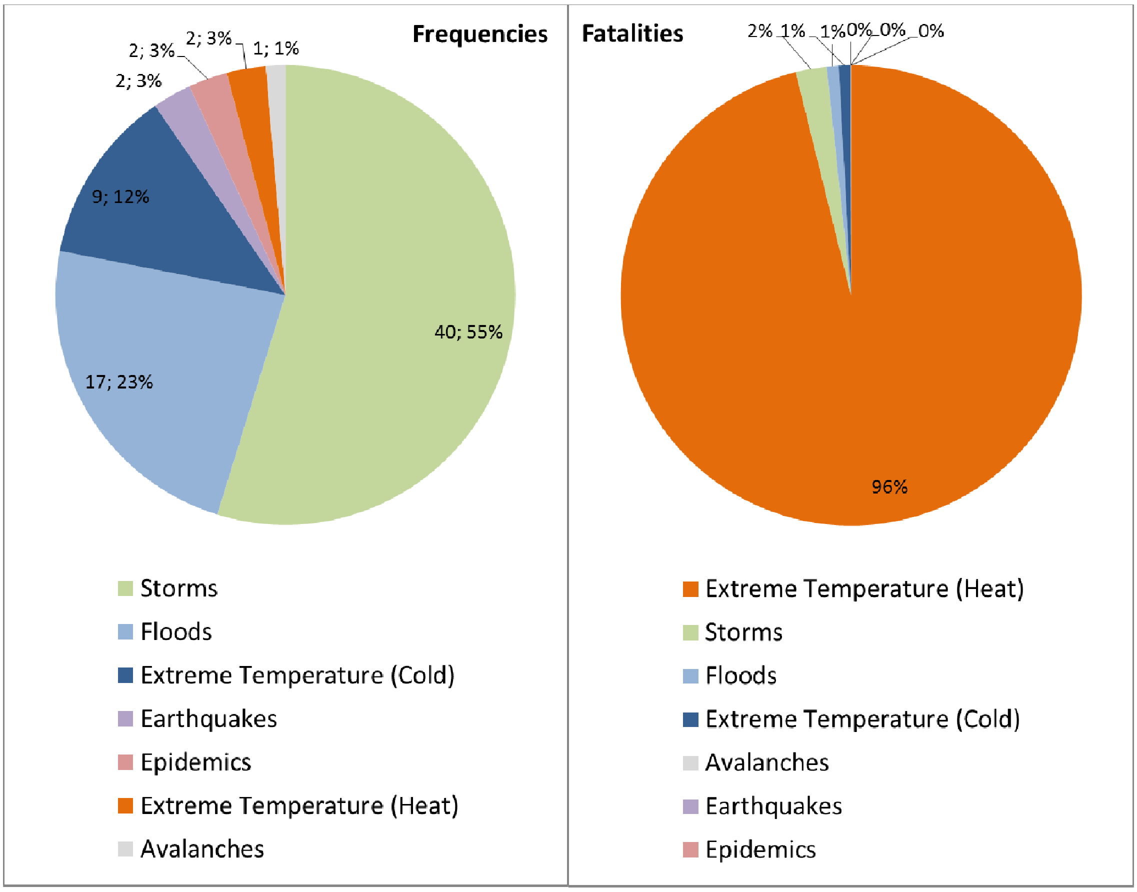


Figure 19: Frequency of different natural hazards of Germany (absolute number of events and percentage of all 73 events; left) and associated mortality (right) for the period 1990 to 2016 (based on EM-DAT, last access 23 April 2017).

While the death tolls arising from natural disasters in Germany are, fortunately, usually relatively low (although very significant on occasion; see Fig. 2 right, approximately 9730 fatalities from 1990 to 2016), the economic losses may be considerable. For example, the worst loss of life from a natural extreme event arose from the August 2003 heatwave which cost the lives of over 9000 people in Germany. Furthermore, storm surges and windstorms caused comparatively high numbers of fatalities: for example, the February 1962 storm surge saw the loss of 347 people at the North Sea, thereof 315 in the City of Hamburg. Apart from the heatwave in 2003, winter storms continue to be the deadliest hazard in the recent past with more than 200 fatalities between 1990 and 2016, followed by floods and cold waves (see figure 2, right).

With regard to economic losses, floods have resulted in the greatest economic losses in the recent past, with the "centennial" August 2002 flood being the worst event causing total losses of EUR 11.6 billion. Already in May/June 2013, another severe and widespread river flood occurred leading to total losses of around EUR 8 billion (Thieken et al., 2016). In May/June 2016, severe surface water flooding occurred at several locations and was partly accompanied by flash floods and debris flows, resulting in overall losses of EUR 2.6 billion (Munich Re 2017), an unprecedented amount caused by surface water flooding. In addition, storms are frequently causing damage. The most recent and expensive examples are the winter storm "Kyrill" in January 2007 causing an interruption of almost the entire railway network in Germany and losses of EUR 4.2 billion (Munich Re, pers. comm.) and hailstorms in July 2013 that hit some cities in Baden-Wurttemberg and Lower Saxony causing total losses of EUR 3.1 billion (GDV 2014). The main hazards that have recently affected the country are storms (winter and summer), floods, and extreme temperatures. It is expected that these hydro-meteorological hazards will increase in intensity and frequency due to climate change (Kreibich et al., 2014). In the following we outline some of the main features of these more important hazard types within the context of Germany. However, there are others that have the potential to inflict significant losses, for example, earthquakes, landslides (which may be triggered by earthquakes, heavy rains or both), wild fires, and magnetic storms (see

Merz and Emmermann, 2006, for a comprehensive listing of potential natural hazards). Only some of these will be discussed below.

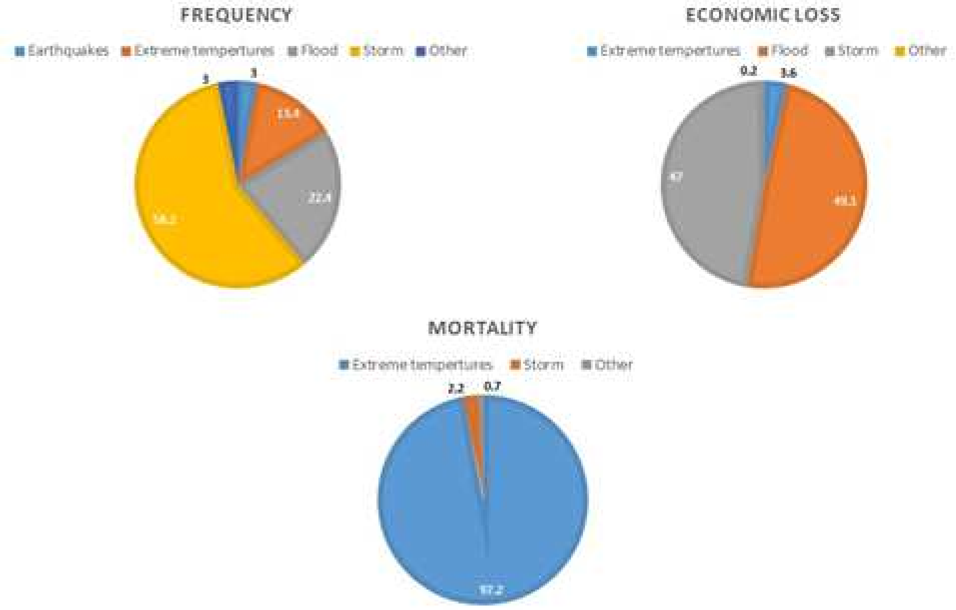


Figure 20: Contribution of the different natural hazards of Germany in terms of percentages (information from the PreventionWeb Germany country profile[7]) for the period 1990 to 2014 (based on EMDAT datasets).

Storms

Storms are the most frequent of the natural hazard in Germany, and have caused approximately 45% of economic and 7% of human losses since 1990 (Kreibich et al., 2014). Nevertheless, it is worth mentioning that storm surges, which are composed of both storms and coastal floods, and thus are multi-hazard events (http://www.ecapra.org; Dyke et al., 2011)., are classified in EM-DAT and other peril classifications as storms. In Europe, storms may be subdivided into winter storms and convective (summer) storms, both of them associated with extreme winds, heavily precipitation and at times, particularly in summer, significant hail. Winter storms or storm cyclones usually develop over the North Atlantic due to high baroclinity between October and March. Severe convective storms, on the other hand, are usually confined to the summer season (May to September) and are the result of thermal instabilities and are relatively short lived (Kreibich et al., 2014).

Winter storms are amongst the more known events that occur in Germany, for example storms Kyrill in January 2007 and Lothar in December 1999, which can lead to damage losses of the order of billions of euros (e.g., Hofherr and Kunz, 2010). As they usually form over the North Atlantic, they decrease in number and intensity from west to east and north to south. The area affected by such storms may cover thousands of kilometres, although the actual intensity depends upon both the maximum gusts (e.g., storm Lothar saw local gusts of 259 km/hr) and the extent. There is also considerable spatial variability, given how wind gust velocities are strongly dependent upon local topography and features (Hofherr and Kunz, 2010).

Severe convective storms are much more localized and frequent events, with some 10 to 40 thunderstorm days per year over Germany. Their probability in Germany decreases from south to north, with several areas showing greater frequency, such as areas south of Stuttgart and Munich (Kreibich et al., 2014). Most damage is

[7] Data available at: http://www.preventionweb.net/countries/deu/data/

caused by large hail, a factor itself dependent upon wind speed and the actual size of hailstone, although Kreibich et al. (2014) comment that local-scale variability and lack of observational systems makes the analysis of their distribution and probability difficult. In recent years, some exceptionally damaging summer storms have occurred. For example, in 2013, a number of hailstorms hit the cities of Hanover in the north of Germany as well as Stuttgart and Villingen-Schwenningen in the south, leading to a total loss of EUR 3.1 billion (GDV, 2014). One year later, the wind storm Ela caused damage of EUR 600 million in North Rhine-Westphalia (GDV, 2015).

Floods

Flood events, which involve a temporary rise in the water level, hold the greatest share of economic losses, making up some 50% of losses since 1990 and are the second most frequent natural hazards occurring in Germany (see Fig. 2 and Kreibich et al., 2014). Floods affecting Germany may be divided into inland events (pluvial and fluvial floods), caused by extraordinary rainfall (and snow melt) and coastal flooding resulting from storm surges. Inland floods affect mainly the western areas (Rhine and Weser catchment areas) during winter (triggered by westerly cyclone events), the eastern region (Elbe and Oder catchments) which also show considerable winter flooding but also spring and summer floods, and the southern region (Danube catchment) which sees flooding during periods of snow melting and summer due to southwest cyclonic activity (Beurton and Thieken, 2009).

Storm surges, which affect the North and Baltic Sea coastlines mainly during winter, arise from sudden abnormal rises in sea-level which are due to the combination of onshore winds and lower atmospheric pressure. The fetch, wind velocity, duration of the storm and water depth define the severity of the emerging storm surge (Kreibich et al., 2014). The specific atmospheric conditions causing these events to differ greatly between the Baltic and North Seas. In the North Sea, the surges are induced by cyclones that develop along the northern North Sea. There are in turn different types of these which lead to different durations and specific areas of impact. For the Baltic Sea, storm surges arise from strong high pressure zones over Scandinavia and a cyclone over central Europe whose influence may extend as far as the Baltic Sea coast. The characteristics of storm surges, high waves, high velocity water flow, and the fact it is salt water, lead to different damage processes when compared to fluvial flooding (Kreibich et al., 2014).

Extreme temperatures

As mentioned above, extreme temperature events, in the form of heat and cold waves, have been the cause of the deadliest natural hazard since 1900 (2003 heatwave, 9355 fatalities, EUR 1.2 billion damage). For Germany, a heat wave is defined often as 5-7 days of temperatures above 30° C (Kreibich et al., 2014). A cold wave in turn is defined as a rapid decrease in temperature within one day that requires increased protection against cold for agriculture, industry and commerce and the general population, which is understood to have durations of days to weeks (American Meteorological Society 2012). Heatwaves are also one of the natural hazards that will increase in intensity and frequency as a result of climate change (e.g., Meehl and Tebaldi, 2004), which in turn would have an influence on urban planning. For example, during the two main heatwaves between 1990 and 2006 in north-eastern Germany, the highest rates of mortality were from the more densely built up areas of Berlin (Gabriel and Endlicher, 2011).

Earthquakes

Although Germany experiences a relatively low level of seismic activity, it is still affected by some of the highest levels of seismicity north of the Alps (Kreibich et al., 2014). There are several regions that have experienced earthquakes of magnitude Mw > 6, leading to macroseismic intensities (EMS-98) of VIII-IX (Tyagunov et al., 2006). The main region of concern is along much of the River Rhine, from Upper Rhine Graben taking in Basel in Switzerland to Frankfurt am Main, and the Lower Rhine Embayment which includes Cologne, and continues to the Netherlands and Belgium. In fact, the largest earthquake in this zone occurred near Basel in 1356 with an estimated magnitude of Mw=6.6. Another area of enhanced seismicity is Saxony-Thuringia (Vogtland) in the east. While the north of the country shows lower levels of seismicity, no part may be considered to be aseismic (see figure 4).

The last most significant earthquake that affected German territory was the 13 April 1992 Roermond (the Netherlands) event, with a magnitude of Mw = 5.3, with total economic losses of EUR 36 million (Tyagunov et al., 2006). Again, around the heavily populated and industrialised area of Cologne, very long return period events of Mw > 6 may occur (~500 years), leading to losses of the order of 10’s of billions of euros, not to mention the loss of life and disruption to the nation´s economic and transport infrastructure (Grünthal et al., 2006; Kreibich et al., 2014).

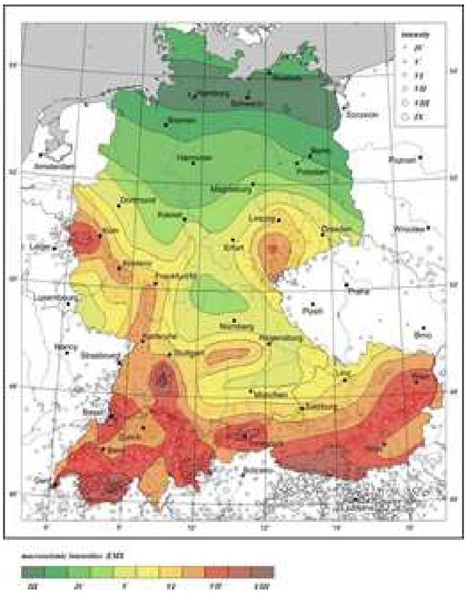


Figure 21: Seismic hazard map for German, Switzerland and Austria in terms of macroseismic intensity (EMS-98 scale) with a 10% probability of exceedance over 50 years (Grünthal et al., 1998).

Research Methodology

In addition to the conceptual framework depicted in figure 1 (see chapter 1), a guideline for semi-structured interviews was prepared by the ESPREssO consortium that was to be used for all national reports with the possibility to modify questions according to the national context. Following this framework, both a literature review and expert interviews were employed to collect qualitative data in form of written and oral texts fitting to the identified categories. Finally, a quantitative analysis was conducted on scientific publications, aiming to find insights on research topics in Germany. This analysis was not exhaustive, given the fact that only a small portion of relevant publications could be included, as explained in the next section.

The qualitative analysis is based on a thorough review of existing scientific literature, agency reports and websites as well as legislative texts. Special attention was paid to grey literature in order to capture the developments within governmental structures, legislative frameworks and institutions related to CCA and DRR. With respect to the scientific literature, on top of the technical reports reviewed, over 40 research projects featured in governmental publications and official websites were used as source material for determining research methodologies commonly used in DRR and CCA. Each project provided information in the form of proposals, final reports and informal communications on web pages that were later aggregated in a single description per project.

Semi-structured interviews were conducted with experts from both CCA and DRR in order to capture their perspectives on progress and gaps of harmonising both fields in the German context. Experts were chosen in order to represent both the CCA and the DRR communities at different levels and from different disciplines. Interviews were conducted with representatives from governmental agencies at federal level (BBK, UBA) as well as federal state level (Conference of the Ministers of the Interior), municipal level (flood protection), different scientific backgrounds (social sciences, hazards, economics) and the private sector (Siemens, GDV). A detailed list of interviewees is provided in the annex.

Data for Quantitative Analysis

Two sources of data were used for the quantitative analysis: Google Trends and Google Scholar. The first source provided information regarding online-search trends for the general German Population, which proves relevant when assessing public interest in Climate Change Adaptation and Disaster Risk Reduction. The second source was used for gaining insights specifically on scientific research aiming to back up the results from the qualitative analysis.

The query to Google Trends was limited to Germany-specific online searches, using two-keyword combinations, namely "*Disaster Management*" and "*Climate Change*", as aggregators of DRR and CCA respectively. In the context of this work, "*aggregators*" are synonym of "*topics*", and can be understood as group of similar words that are semantically related. The results obtained were time series depicting the popularity of each topic through the years.

Regarding the query to Google Scholar, the search terms: <*"disaster risk reduction" "Germany" "BMBF"*> and <*"Climate Change Adaptation" "Germany" "BMBF"*>[8] were used and the results were ordered by relevance. While these terms were empirically found to provide the most results, even for research not funded by the BMBF, it should be taken into account that certain bias may exist in the analysis towards projects funded by that source.

Taking a small representative sample from the enormous number of available documents required careful analysis. To reduce the potential bias, characteristics of the data to be included need to be defined to enable a

[8] BMBF stands for Bundesministerium für Bildung und Forschung, the Federal Ministry of Education and Research

meaningful selection of documents. For this particular approach, two characteristics were considered when surveying papers:

A. **Temporal dimension:** Scientific documents published longer than ten years ago were not considered.

B. **Relevance in the field:** This characteristic was assessed through the number of citations each paper possesses. A minimum threshold of five citations was set for papers to be accepted in this review. This criterion implies that recent papers were not considered in the analysis, not due to lack of relevance, but lack of citations, and is a challenge that remains open for further analysis.

Furthermore, and since the analysis focused on Germany-based research, other characteristics such as degree of contribution per country were considered. This was easily assessed by aggregating authors according to the country where that particular research was carried out, and selecting only those papers where German contributions represented the majority of the work. These criteria resulted in a corpus of 16 documents for Disaster Risk Reduction and 38 documents for Climate Change Adaptation (see Annex 2). These papers were later aggregated in three specific documents, corresponding to CCA, DRR and approaches combining both. All documentation was acquired as PDF files that were later converted to plain text files.

Data Analysis

Qualitative Analysis

Thematic analysis (cf. Guest, 2012; Gibbs, 2007) was employed throughout the report as the primary qualitative research method (Braun & Clarke, 2006) to identify and organize key themes from qualitative data according to the conceptual framework. Since the conceptual framework for analysis was already developed, the coding process was concept-driven (cf. Gibbs, 2007, p. 44ff), but codes were amended throughout the analysis to include new categories that were derived from the texts. The program used for this analysis was coded in R and included the following collection of R libraries: *topicmodels*[9], *tm*[10], *pdftools*[11] and *wordcloud*[12].

Quantitative Analysis

In addition to the qualitative analysis, two automated techniques were employed to gain insights on scientific research in Germany, with special attention to its relation to DRR and CCA. This analysis was conducted using the previously acquired scientific articles as text data input.

The first step required to convert all PDF files into plain text data using the *pdftools* library, and merge all individual documents into one single text file. After applying an automated algorithm for cleaning this data from common words that provide no relevant information (such as "the", "a" or "some", to name a few), a simple analysis of frequency was employed to find the most relevant keywords in the scientific documents previously acquired. This part of the analysis used the *tm* package, and consisted basically on keyword indexing according to the frequency in which they are used throughout these texts. The outcome of this methodology is the form of an ordered list with the most popular keywords used throughout the texts. While this analysis provides little added value by itself, it finds its stronger contribution when paired with a stronger analysis, such as topic modelling.

Topic Modelling was used to identify patterns within the selected articles. This technique aims at identifying "*topics*" which would normally generate similar keywords[13]: "Topic modeling algorithms are statistical methods

[9] https://cran.r-project.org/web/packages/topicmodels/index.html
[10] https://cran.r-project.org/web/packages/tm/index.html
[11] https://cran.r-project.org/web/packages/pdftools/index.html
[12] https://cran.r-project.org/web/packages/wordcloud/index.html
[13]For further information on the methodology of topic modelling cf. Jordan 2003; Griffiths, Steyvers 2002,2003,2004; Hofmann 1999,2001

that analyze the words of the original texts to discover the themes that run through them, how those themes are connected to each other, and how they change over time" (Blei, 2012).

The goal of Topic Modelling is discovering the abstract "topics" that best describe a document or a collection of documents. Such a technique is used in this report as a mean to find structured information from high volumes of text data, a task which would have required significantly more time or resources than available, if a traditional literature review had been used. The approach of Topic Modeling in text analysis can be better understood with an example: if a document frequently uses the keywords "*Temperature*", "*Water Levels*" and "*Ozone*" for similar sentences, then a theme or topic might be identified in the document. While the algorithm would not be able to assign a name to this topic, this task falls on the user (or even hired professionals paid by word). In this case, the user possibly would name this topic "*Climate Change*". On the other hand, keywords such as "Catastrophe", "Critical Infrastructures" and "Prevention" frequently used together, may determine a topic such as "Disaster Management". In both cases, the algorithm just clusters the words together, and the user names the cluster.

The insights obtained through this technique should not be considered as truth in itself but a support of the approach used for the qualitative analysis, which always takes precedence in this report.

Institutions in Disaster Risk Reduction and Climate Change Adaptation in Germany

The definition by UNISDR declares disaster risk reduction (DRR) to be "the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events" (UNISDR, 2009). Therefore, DRR "refers to a wide range of opportunities for risk abatement and disaster management. Risk reduction includes prevention, preparedness, and part of the recovery process, and it gives particular emphasis to the reduction of vulnerability" (Ammann, 2013). Different strategies/measures can be distinguished and combined. With regard to flooding, Hegger et al. (2014) distinguished five risk reduction strategies: 1) loss prevention by an adapted use of flood-prone areas, 2) risk mitigation by flood-adapted design and use of buildings; 3) flood defence with structural protection measures, 4) preparedness for response, e.g. by flood warning and adaptive behaviour; and 5) risk transfer mechanisms such as flood insurance to compensate flood losses.

In this understanding, DRR is no longer framed as a "a post shock-oriented tool to restore communities affected by disasters to their pre-disaster condition" (Birkmann et al., 2009, p. 6) but rather as a set of useful instruments for adapting to changes before events occur. Arising from this, potential synergies with Climate Change Adaptation (CCA) in terms of similar aims and mutual benefits could lead to an increased effectiveness and sustainability of both approaches.

While the DRR concept allows for a rather inclusive and broad classification of potential measures, actors, structures and institutions, in a national context the term itself is hardly used to describe the responsible official structures dealing with disasters. Rather, structures are classified according to the departmental portfolios under which they fall. Most of DRR is therefore coined as e.g. civil protection, water management, land use planning or urban planning. In order to narrow down the topic of DRR within this report, special attention will be paid to civil protection, corresponding to the national structures.

DRR in terms of civil protection has a long tradition in Germany. While civil protection before World War II usually meant civil defence in the event of war, today the institutional structures of civil protection mainly come into operation in case of natural disasters. The terminology and history of civil protection in Germany and its unique architecture as well as the most important institutions will be described in section 2.1.

Likewise, with the German Strategy for Adaptation to Climate Change („Deutsche Anpassungsstrategie an den Klimawandel"(DAS)) that was passed in 2008 and the several follow-up frameworks, CCA can now be understood as a policy field of its own in Germany (Bubeck et al., 2016). The most important institutional structures and policies in relation to CCA will be described in section 2.2. After looking at both fields separately, section 2.3 will describe the existing harmonisation of both fields in the German context.

Legal Structures and Institutions in Relation to DRR in Germany

Understanding the German Context: Terminology and a brief History of DRR in Germany

While often used as synonyms in public debates and media, the German terminology regarding DRR has many qualitative distinctions including different legal implications that need to be understood when talking about the policies and laws of German disaster risk reduction. The most common terms are civil protection („Zivilschutz"), disaster control („Katastrophenschutz") and the protection of the population („Bevölkerungsschutz"). While the last is usually not used in English and rather translated with civil protection, the distribution of tasks between different governance levels within Germany makes such a distinction useful:

While civil protection (“Zivilschutz”) is considered as part of national defence policies, for which the Federation in form of the Federal Ministry of the Interior is responsible under German constitutional law (Article 73, paragraph 1, German Constitution (Basic Law, “Grundgesetz” (GG)), disaster control (“Katastrophenschutz”) is under the responsibility of the federal states (“Länder”) (Article 30, and 70, paragraph 1, GG). However, both are interlinked and – under certain conditions - can call upon each other`s resources. When talking about both, civil protection and disaster control, hence referring to the general protection of the population regardless of the administrative level of responsibility, “Bevölkerungsschutz” would be the right term – following the definition of the Federal Office of Civil Protection and Disaster Assistance (cf. Geier 2013: 28)[14]. Bevölkerungsschutz includes all non-military and non-police measures taken by any administrative level to protect the population from disasters, other severe crises and emergencies as well as from the impacts of any armed conflict. It also includes measures to prevent, reduce and manage such events, i.e. the term contains measures of disaster risk reduction (ibid). Figure 5 provides an overview of the German terminology.

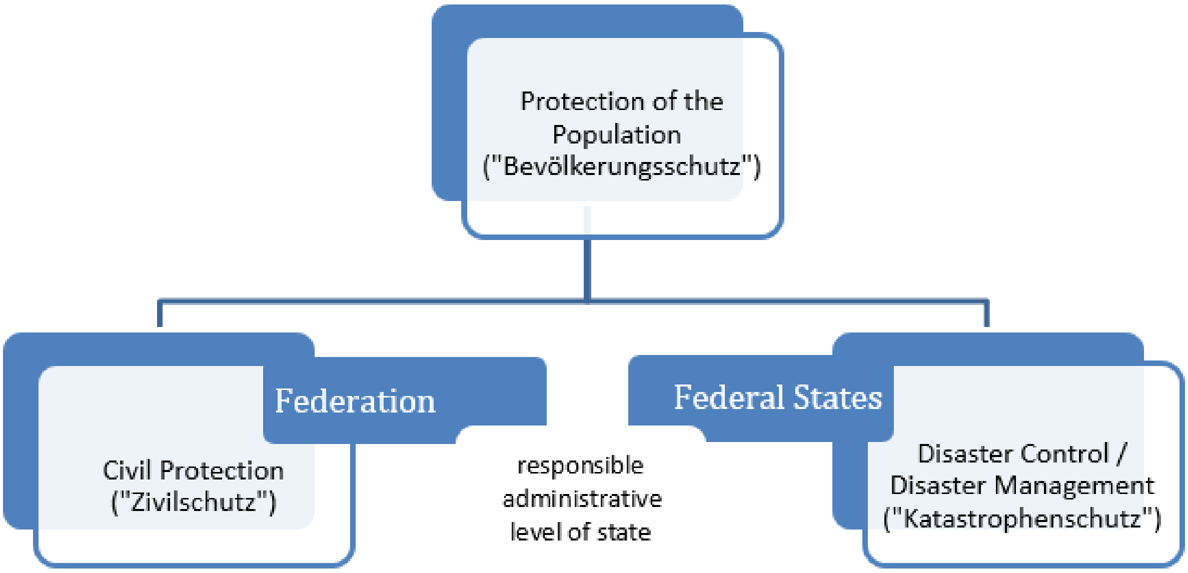


Figure 22: German DRR Terminology

Measures of prevention and preparedness in terms of peacetime disasters were not a priority of German policies until the late 1960s. Disaster control as a task of the federal states was not organized, structured nor standardized. Fire protection and the organization of fire brigades were considered as the responsibility of municipalities (as a result of the allies` politics), while the Emergency Medical Services were entirely in the hands of private relief organizations. This is one major reason for the strong position of private relief organisations, fire brigades and other volunteer-based NGOs within the German DRR system (ibid) as will be explained further in sections Non-governmental organizations and The role of volunteers in German DRR.

Despite the nuclear threat of the 1970s and 80s, civil protection in Germany remained very much conventionally oriented and underfinanced. The German reunification process brought about more cutbacks in civil protection budgets and many programmes were given up without having an overall concept for the restructuring. There was not much professional debate about how to address new threats and challenges in civil protection and disaster control until September 11, 2001 and the massive Elbe flooding in the summer of 2002.

[14] Usually translated as “civil protection”

As a reaction to these events that came as a "wake-up call", in 2002, the Federal Government as well as the federal states agreed on a "New strategy for the protection of the population in Germany" (BBK, 2010a) which emphasizes emergency preparedness and disaster prevention. It underlines the joint responsibility of the Federal Government and the federal states in situations which threaten serious damage to the welfare of the nation. One important contribution of the Federal Government to this new strategy for the protection of the population in Germany was the establishment of the Federal Office of Civil Protection and Disaster Assistance (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe; BBK) in 2004. The BBK is a supreme federal office within the portfolio of the Federal Ministry of the Interior (Bundesministerium des Innern; BMI) which - together with the Federal Agency for Technical Relief (Technisches Hilfswerk; THW), takes measures in the field of civil protection and disaster assistance and supports the BMI, i.e. the responsible federal ministry, in these areas (BBK, 2010b). BBK has, among others, the statutory obligation for the development of national risk analysis, warning and informing the population[15], education, further education and training, support of municipalities to prepare for emergencies as well as technical and scientific research.

Today, the protection of the population i.e. "any civilian measure taken to protect the population and its livelihood from the impact of wars, armed conflicts, disasters and other major emergencies as well as any measure taken to prevent, mitigate the impact of and cope with these events" (BBK, 2012) is a key component of Germany`s national security architecture. In general, the non-police aversion of danger in Germany is built upon a vertically structured, subsidiary system that heavily relies on volunteers (Weinheimer 2008: 135). This system is rather complex since it involves both state actors (on national level, state level as well as municipal level) and non-governmental organizations. The different levels of operative responsibilities as well as the vertical collaboration between both state actors and non-state actors will be described in the following sections.

National Level: Relevant Institutions and Legislative Frameworks for DRR

As mentioned above, according to the Basic Constitutional law (GG, Article 73 Paragraph 1 Number 1), the federation is responsible for the protection of the population against war and other military conflicts. In all other cases the federal states (Länder) are responsible. As a reaction to the terrorist attacks of 9/11 and the massive Elbe flood in 2002, the Standing Conference of the federal and state interior ministers adopted the "New Strategy for Protecting the Population" („Neue Strategie zum Schutz der Bevölkerung in Deutschland") the same year. This strategic framework was to strengthen the collaboration between federation and federal states in dealing with extraordinary, large-scale or nationally significant threats and damage. With this framework, the German government intended to review and renew the system of civil protection to prepare the system for current challenges - including climate change:

"[…] the existing systems at the federal and at the state level were developed further so as to give special priority to the synergetic deployment of resources by the various players in national crisis management in view of threats such as international terrorism, proliferation of weapons of mass destruction, epidemic and pandemic diseases, man-made disasters and the growing number of natural disasters (climate change)" (BMI 2015: 5).

The new strategy was to create a win-win situation for federation and federal states with assisting the Länder in dealing with disasters in times of peace while the federation's staff and material are used and trained to be fully operational in case of defence (BBK & DKKV, 2009, p. 122). By setting up the Federal Office of Civil Protection and Disaster Assistance (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe) in 2004, the federal government increased its coordinating role and shifted the federal focus away from Civil Defence more towards the subsidiary task of administrative assistance in disaster management.

[15] However, weather warning is the responsibility of the DWD, hence, a close cooperation between both institutions is essential, cf. section **National Meteorological Service** on the DWD

The responsibilities at federal level have since then been constantly revised and were formalized in the Federal Civil Protection and Disaster Assistance Act (Zivilschutz- und Katastrophenhilfegesetz; ZSKG (Bundestag der Bundesrepublik Deutschland, 2009)) which - for the first time - established a legal basis for the fact that the whole of society shares responsibility in case of large scale damage that crosses the borders of federal states (Meyer-Teschendorf 2008, p.4).

However, in 2016 the government adopted a new concept for civil defence („Konzeption Zivile Verteidigung“) (BMI, 2016) which elaborates especially the tasks of the federation when averting severe threats regarding four main fields of responsibility, i.e. 1. maintaining the functions of the state, 2. civil protection, 3. supplying to the population, 4. supporting the armed forces. The concept is therefore the basis for taking concerted action at inter-departmental level and might necessitate an update of the ZSKG.

Ministries and Agencies

3.0.1.0.1 *Federal Ministry of the Interior*

Among the federal ministries, the Ministry of the Interior (Bundesministerium des Innern (BMI)) is responsible for security matters (public security, data security, internal security, protection against disasters and terrorism). It plays a central role in managing crises taking place within the country and hosts the Standing Committee of Interior Ministers. The ministry's crisis task force may be called on in case of serious threats to internal security to manage the situation and to coordinate measures taken by the BMI and its agencies. It also coordinates between the federal ministries and the Länder and provides advice for political actors. The crisis task force is called upon by the Communications, Command and Control Centre at the BMI (BMI 2015).

Within the ministry, the Directorate General Crisis Management and Civil Protection functions as Crisis Management Coordination Centre and Communications, Command and Control Centre of the ministry. It also has the administrative supervision of the two major institutions within the remits of the Ministry of the Interior that are dealing with civil protection, i.e. the Federal Office of Civil Protection and Disaster Assistance (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK)) and the German Federal Agency for Technical Relief (Bundesanstalt Technisches Hilfswerk (THW)). Both agencies are described in more detail below.

3.0.1.0.2 *The Federal Office of Civil Protection and Disaster Assistance (BBK)*

The Federal Office of Civil Protection and Disaster Assistance (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK)) was established as a contribution of the federation to the New Strategy for Protecting the Population within the portfolio of the BMI in May 2004 to create a central organisational element working to ensure the safety of the population.

The work of the BBK includes carrying out the tasks of the Federation especially with regard to the:

- Development of a national risk analysis (see section National Risk Analysis),
- Development of standards and framework concepts for civil protection,
- Warning and information of the general public,
- Development of a modular warning system with the core element of satellite-based warning information by including the existing and future alert and warning media,
- Information of the population about protection and support possibilities,
- Promotion of training measures for the general public,
- Education, further education and training of decision makers and managers from the sector of civil security measures (see also section Academy for Crisis Management, Emergency Planning and Civil Protection (AKNZ)) and
- Support of municipalities with regard to self-protection measures.

Therefore, the office is supposed to bundle all major activities in civil protection and connect them where they are interlinked. Some of the BBK´s departments and activities will be discussed in more detail below.

3.0.1.0.3 Academy for Crisis Management, Emergency Planning and Civil Protection (AKNZ)

The Academy for Crisis Management, Emergency Planning and Civil Protection (Akademie für Krisenmanagement, Notfallplanung und Zivilschutz (AKNZ)) forms Division lV of the BBK and is the central educational institution of the federation regarding risk and crisis management as well as civil protection. The aim is to develop the academy into an educational institution for civil safety precaution with a national and international network, within the framework of a strategic educational alliance. The seminars and courses target at all five pillars that constitute civil safety precaution on a national level (civil protection, police, the armed forces, services, critical infrastructure companies). Annually, around 10.000 staff from federal and federal state level at all administrative levels as well as from the relief organisations are trained within the AKNZ (BBK 2013b).

3.0.1.0.4 German Federal Agency for Technical Relief

The German Federal Agency for Technical Relief (Bundesanstalt Technisches Hilfswerk (THW)) was founded in 1950 as the federal civil protection agency on behalf of the Federal Ministry of the Interior. On a national level, the THW provides technical relief under Section 1 (2) of the Act on the Federal Agency for Technical Relief (THW-Gesetz) in accordance with the Federal Civil Protection and Disaster Relief Act. Being a Federal agency, THW belongs to the department of the Federal Ministry of the Interior. However, the agency`s structure is unique: Only one percent (ca. 1000 individuals) of the staff is employed full-time by the authority. 99 percent of the THW-members work on a voluntary basis. Nationwide more than 80,000 volunteers who provide professional assistance during their leisure time in 668 local sections where the volunteers are also trained for operations[16]. According to THW (2016) "volunteers worked for about 1.3 million operational hours in 2015 at the request of different parties (e.g. police, fire brigade, civil protection authorities, municipalities, district presidents, Länder governments, federal government or European Union)". This basis of volunteers is very typical for the overall German civil protection system and will be discussed further in section The role of volunteers in German DRR.

In terms of operational units, the THW has at its disposal around 1,440 rescue groups and 1,000 specialist units in 722 technical platoons as well as more than 8,400 vehicles. Furthermore, it can provide specialised Rapid Deployment Units and Modules for foreign operations, e.g. in case of supporting EU or UN missions as well as a special training center (THW-Bundesschule) (THW 2016).

German Laws on Flood Protection

The overall regulatory law for water management in Germany stipulates that water bodies are subject to state management. The most important federal law is the Federal Water Act (Wasserhaushaltsgesetz, WHG) which was originally adopted in 1957. The major flood in August 2002 induced legislative changes so that a substantially revised version entered into force in 2010 after transposition of the EU Water Framework Directive (WFD) into German national law. Regarding DRR, particularly the German Flood Protection Act of 2005 (Artikelgesetz zur Verbesserung des vorbeugenden Hochwasserschutzes) and the European Floods Directive (2007/60/EC; EC 2007) introduced important changes which marked a shift towards a more integrated flood-risk-management system in Germany that also considers non-structural measures to minimize adverse effects of flooding (DKKV, 2015b; Thieken et al., 2016; Hartmann and Albrecht 2014).

Furthermore, the EU Floods Directive requires that member states prepare flood hazard and risk maps for areas with (potentially) significant flood risk and establish flood risk management plans that outline plans for the implementation of prevention, protection and preparedness measures. Above all, the Floods Directive demands a review of such instruments in an iterative optimisation process. A thorough analysis of the flood in

[16] More specialised advanced training is conducted in a federal training center (THW-Bundesschule) with two locations. About 6.000 people are trained here each year (THW, 2017)

2013 (DKKV, 2015b) shows that considerable improvements have been made on many levels that deal with flood risk reduction and disaster response in Germany, in particular in 1) increased consideration of flood hazards in spatial planning and development, 2) comprehensive private precaution and self-provision, 3) more effective early warning and improved coordination of disaster response and 4) a more targeted maintenance of flood defence systems.

However, implementation of the aforementioned changes to the WHG were still dominated by structural flood defences. It is rather after the flood in June 2013, that “bigger strategic changes are discernible. The systematic search and creation of retention space seen in the National Protection Program is one example of a further rejection of a purely protective concept, even if this is not always reflected in the terminology” (Thieken et al., 2016).

National Strategy to Protect Critical Infrastructure

The strategies regarding Critical Infrastructure Protection (CIP) are among the few national strategies regarding DRR, showing the importance of CIP for an industrialized country like Germany. The National Strategy to Protect Critical Infrastructure (2009) summarizes the aims and strategic approach of federal policy in this area. The CIP Strategy itself defines Critical Infrastructure as “organizational and physical structures and facilities of such vital importance to a nation's society and economy that their failure or degradation would result in sustained supply shortages, significant disruption of public safety and security, or other dramatic consequences“ (BMI, 2009).

The document lists several work packages that are to be jointly implemented by the Federation, the federal and local governments to enhance CIP in their respective areas of responsibility:

“1. definition of general protection targets; 2. analysis of threats, vulnerabilities, and management work packages capabilities; 3. assessment of the threats involved; 4. specification of protection targets, taking account of existing protective measures; analysis of existing regulations and, where applicable, identification of additional measures contributing to goal attainment; if and where required, legislation. These work packages are implemented primarily by the public sector, with the collaboration of the companies and operators concerned. Responsibility for coordination at the federal level lies with the Federal Ministry of the Interior” (BMI, 2009). According to interviewed experts, the National Strategy to Protect Critical Infrastructure was revised in 2016 / 2017. Consultations between the involved government departments have taken place and comments are being incorporated as of April 2017.

Another action within this field is the initiative UP KRITIS, a Public-Private Partnership for Critical Infrastructure Protection which was institutionalised in 2007 (UP KRITIS, 2014) as a result of the Federal Government's “National Plan for Information Infrastructure Protection” (Nationaler Plan zum Schutz der Informationsstrukturen (NPSI)) from 2005, out of which the CIP Implementation Plan emerged in 2005 and 2006[17].

Federal State (“Länder”) Level

Since the responsibility for disaster management in terms of civil protection lies with the “Länder”, each federal state`s government has the right and responsibility for policy formulation in the area of civil security, typically through its Ministry of the Interior. The departments of the interior on federation and federal state level meet regularly to coordinate their activities in the Permanent Conference of Interior Ministers[18] ("Ständige

[17] With regards to IT security, see also the Germany’s Cyber Security Strategy 2011 and 2016 (BMI 2011, BMI 2016)

[18] This governance structure is quite common in Germany. Similar “conferences” exist e.g. with regard to the environment (Conference of Environmental Ministers, Umweltministerkonferenz; UMK) including all water issues such as floods and droughts as well as in the justice department (Conference of the Ministers of Justice, Justizministerkonferenz; JuMiKo). The JuMiKo discussed for example the possibilities of a compulsory insurance covering losses caused by natural hazards.

Konferenz der Innenminister und -senatoren der Länder", short: Innenministerkonferenz (IMK)) under the lead of a rotating presidency.

Working group V of the IMK (Arbeitskreis V - Feuerwehrangelegenheiten, Rettungswesen, Katastrophenschutz und zivile Verteidigung / Fire Fighting Issues, Rescue Services, Disaster Prevention and Civil Defense) brings together professionals and lead officials in the areas of civil protection and disaster relief. The working group has written plenty of position papers and recommendations to harmonize operational doctrine and civil protection structures across the Länder and local authorities. It also “served as the key negotiation forum for the legislative reforms to the German emergency management system from 2002-2009” (Hegemann & Bosong, 2013, p. 12).

The federal states are especially responsible for legislation on rescue and emergency services, fire protection and disaster management. They support the districts and municipalities with their tasks and take over the overall coordination in case of large-scale hazards, damage or disasters. On the basis of the states' laws, some divergent structures regarding management, education and equipment have evolved over the years (BMI 2017).

Depending on the respective laws of the respective federal state, the first authority in charge during a peacetime disaster is either the cognizant rural district, county or the municipal authority. The local response is managed by the director of administration for the respective authorities. If necessary, a staff is established consisting of members from his or her own administration, as well as other authorities, services and organisations involved in disaster management to assist with administrative duties. When several districts are affected by an event or a local government cannot handle an event on its own the next highest hierarchical authority takes over the coordination. According to the Basic Constitutional Law (GG, Article 36) federal authorities render legal and administrative assistance to the federal states in cases of especially large scale impacts or natural disasters and accidents affecting more than one state. The federal government supports local and regional authorities and the states with a) information, coordination, and advice as well as with their own operational forces (e.g. with services provided by the BBK, the THW, the federal police, and, with certain limitations (with regards to the use of weapons) the Armed Forces) when asked for assistance (BMI 2015: 6). In this case, an inter-ministerial coordination group may be set up within the BMI which together with other federal ministries and the other states, ensures the coordination of assistance to the affected federal state. However, the right of initiative and the disaster management remains with the federal states (German Red Cross 2010).

Municipal Level

Even though the federal states have the legislative and executive power according to the Basic Constitutional Law (GG, Article 83), disaster relief is to a large extent planned and implemented on a local level (following the subsidiarity principle): while e.g. the legal responsibility concerning fire brigades lies with the Länder, the fire brigades are run by municipalities which together with the relief organizations make up the core of non-military and non-police civil protection staff. The fire brigades and relief organizations undertake operative and tactical measures for disaster reduction and response under the lead of the responsible operational command of the respective civil protection authority (Katastrophenschutzbehörde). 95% of this emergency personnel serve on a voluntary basis (BBK & DST:10) as explained in more detail in section The role of volunteers in German DRR. In case of an event, the district chiefs or chief mayors are politically responsible managing the crisis. They are supported by a management staff to be established in case of an emergency as well as by a command staff/operational command post (BBK 2013) – both on the level of municipal districts and autonomous cities as well as on the level of the federal states[19].

[19] For a detailed account of the command structures in case of emergency as well as in the everyday administration of municipalities see German Fire Brigade Service Regulation FwDV 100 (1999) as well as Ehl & Wendekamp (2013, p. 133ff)

Vertical Cooperation

Since the New Strategy for the Protection of the Population in Germany was passed in 2002, there is a close cooperation between federation and federal states to make effective use of personnel and equipment. The BBK has several activities directly targeting vertical cooperation that will be described below.

Interministerial Coordination Group of the German Government and the German States

The Interministerial (Crisis Management) Coordination Group (Interministerielle Koordinierungsgruppe des Bundes und der Länder (IntMinKoGr)) coordinates between the Länder and federal levels. It plays an important role alongside the existing federal and state crisis management system, dealing with the limited number of threats or emergencies which affect more than one state over a longer period of time (e.g. accidents at nuclear power plants in Germany and abroad, pandemics and major natural disasters). In such cases, the IntMinKoGr focuses on the necessary coordination and consultation to deal with complex situations (BMI 2015).

Joint Information and Situation Centre of the Federal Government and the Länder

The Joint Information and Situation Centre of the Federal Government and the Länder (Gemeinsames Melde- und Lagezentrum von Bund und Ländern (GMLZ)) is to guarantee that the Federal Government, Länder and relief organisations have the same information about a certain event. As a central component of restructuring the German civil protection after 2002, the GMLZ was already set up in October 2002 - two years before the establishment of the BBK itself. Since the ZSKG came into force, the basis of the GMLZ`s tasks is § 16 ZSKG with the following three main tasks:

1. Situation management:

   One of the central tasks is the creation of a constantly updated and extensive situation assessment of issues relevant to civil protection in Germany and abroad. The focus hereby is not on observation alone but on evaluation and analysis of situational developments. These are incorporated into certain products that are shared with the relevant partner organisations on a regular basis (such as a daily situation report). The aim is to comprehensively inform all partners such as federal states, ministries, relief organisations, THW, neighbour states, EU and NATO about relevant events at an early stage.

2. National-Contact-Point (NCP)

   The GMLZ is the central contact point for around 20 national and international information and alert mechanisms. Since the centre can be reached 24/7, the GMLZ is responsible for informing and alerting the responsible ministries and agencies outside of normal business hours. Furthermore, the GMLZ exchanges information with the situation centres of other EU member states and the EU commission`s Emergency Response Coordination Centre (ERCC) in Brussels. In international disaster control missions with German participation the GLMZ coordinates the sending of units, aid supplies or experts in international disaster relief (BBK 2017).

3. Resource management

   Resource management includes the procurement and distribution of bottleneck resources (e.g. during the Elbe and Danube floodings in 2013 the GLMZ obtained 1.25 million sandbags from neighbouring countries to the affected federal states).

National Risk Analysis

According to the Civil Protection and Disaster Assistance Law (ZSKG, Section 18, Paragraph 1), the federal government and the federal states have to jointly generate a national risk analysis for civil protection. The national Risk Analysis is key to the advancement of the German System of National Security and part of the “New strategy for the protection of the population in Germany”. Therefore, the BBK has developed a risk assessment method for civil protection which has been made available to the federal states. The findings of the national risk analysis serve as a basis for informed decision making and a risk-based planning of prevention and preparedness activities. Aim of the analysis is to come to a comprehensive overview of potential risks and events regarding the probability of occurrence and the extent of damage that is to be expected. This way, the government can also use the risk analysis to capture hazards of national importance. The outcome, the "Joint Hazard Estimation of the Federals States and the Federal Government", compiles hazards which exceed day-to-day events and identifies risk hotspots and means to reduce vulnerability. To systematically improve the assessment, BBK also engages in a regular exchange on risk management methods and results both within and outside Europe (DKKV, 2015a).

The analysis is carried out in an abstracted, generic manner and does not attempt to prioritize specific scenarios or to conduct a political evaluation of risks. The following risk analyses have been carried out since 2012: flooding, extraordinary epidemic event, winter storm, storm surge, release of radioactive materials from a nuclear power plant and release of chemical substances. The analysis that is currently ongoing will deal with a massive gas shortage (Deutscher Bundestag 2016).

On the basis of the developed and examined scenarios, risk assessment procedures that were accordingly adapted for the respective administrative levels were applied already at the district and independent town level, in order to carry out detailed analyses as part of pilot projects. In early 2016, the BBK made a guideline for the implementation of risk analyses, including the steps for risk assessment and risk management, available to the public agencies in the affected administrative levels as well as publicly accessible online (BBK 2015). Using scenario-based risk analyses, the existing abilities and coping capacities in disaster protection as well as the general danger defense were subjected to a stress test (Fekete & Hufschmidt, 2016).

The German parliament is regularly informed about the progress and the outcomes. The national risk analysis process is listed as a contribution to CCA in Germany in the progress report of the German adaptation strategy (as a couple of the scenarios are particularly relevant in that context).

3.0.4.2.1 Exercises on crisis management: LÜKEX

The so-called LÜKEX (**L**änder**ü**bergreifende **K**risenmanagement-Übung **Ex**ercise) are interministerial and interstate crisis management exercises involving both the Federal Government and the Federal States to prepare for (exceptional) crises and threats to provide them with an opportunity to test existing crisis management plans and mechanisms. While the overall responsibility for the exercises lies with the Federal Ministry of the Interior (BMI), they are prepared, implemented and evaluated by a project team within the Federal Office of Civil Protection and Disaster Assistance (BBK). The aim of LÜKEX is to enhance the cooperation between all actors in the political-administrative system who bear responsibility in the area of civil defence. Focusing on the crisis committees on the federal and the state level, operators of critical infrastructure and other safety-relevant facilities have to be involved in the exercise (BBK 2014: 7). LÜKEX are also supposed to determine the need for action where there are no established or no sufficient procedures for collaboration or consultation channels in place. The exercises usually take place every two years which corresponds with the approximate time of completing one exercise. Since 2009 LÜKEX has been part of the Federal Civil Protection and Disaster Assistance Act (ZSKG § 14). The next exercise is planned for 2018 and - in line with the current national risk assessment - will deal with a massive gas shortage event[20].

Implementing International DRR Frameworks in Germany

The Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) was adopted at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015 and replaces the Hyogo Framework for

[20] In 2015, the planned LÜKEX (with the scenario of an extreme storm surge) was cancelled due to the degree of capacity utilisation of the federal states in tending to the higher numbers of refugees.

Action 2005-2015 (HFA). The German Delegation in Sendai consisted of representatives from BMZ, AA, BMI, BBK, DKKV as well as other experts and "during the negotiations, Germany was one of the countries that called for the development of indicators to enable progress on the goals agreed under the Framework to be measured against established global benchmarks for the first time"[21].

The Sendai Framework focuses on comprehensive risk management. Its priorities are to improve understanding of disaster risks, to strengthen local, national and international steering mechanisms for managing disaster risks, to invest in disaster risk reduction in order to enhance resilience, to improve preparedness for disasters in order to ensure an effective response to them and to facilitate preventive reconstruction ("building back better"). The national focal point for the Sendai Framework and UNISDR is going to be within the remit of the BMI. The Secretariat will be based at the BBK from summer 2017 onwards.

International Cooperation: Transboundary Disaster Management

The European Civil Protection Mechanism (CPM) is the main framework for cross border cooperation on disaster relief within the EU[22]. This mechanism was put in place to improve the coordination of the work carried out by civil protection and relief services in the event of a major emergency extending to all 28 EU Member States in addition to Iceland, Montenegro, Norway, Serbia, the former Yugoslav Republic of Macedonia and Turkey. Any country affected or likely to be affected by a major disaster – within or outside the EU – may call upon the Member States´ for assistance. According to the German Red Cross (2010), "Germany has not yet requested assistance via this mechanism and thus has not gained any practical experience in this area". However, cooperation on disasters between Member States is often based on geographic proximity or on similar hazards that countries face. Likewise, Germany has signed bilateral agreements on mutual disaster assistance with all its neighbour states as well as with Russia, Hungary and Lithuania, i.e. agreements with the following countries are in place:

- Belgium
- Denmark
- France
- Lithuania
- Luxembourg
- The Netherlands
- Austria
- Poland
- Russia
- Switzerland
- The Czech Republic
- Hungary[23]

[21] http://www.auswaertiges-amt.de/EN/Aussenpolitik/HumanitaereHilfe/2_Katastrophen/HuHi_Preparedness_node.html

[22] http://ec.europa.eu/echo/what/civil-protection/mechanism_en

[23] Abkommen zwischen der Bundesrepublik Deutschland und dem Königreich Belgien über die gegenseitige Hilfeleistung bei Katastrophen und schweren Unglücksfällen v. 6. November 1980 (BGBl. 1982 II, p. 1006) („German-Belgic Agreement"), Abkommen zwischen der Bundesrepublik Deutschland und dem Königreich Dänemark über die gegenseitige Hilfeleistung bei Katastrophen und schweren Unglücksfällen v. 17. März 1988 (BGBl. 1988 II, p. 286) („German-Danish Agreement"), Abkommen zwischen der Bundesrepublik Deutschland und der französischen Republik über die gegenseitige Hilfeleistung bei Katastrophen und schweren Unglücksfällen v. 3. Februar 1977 (BGBl. 1980 II, p. 33) („German-French Agreement"), Abkommen zwischen der Bundesrepublik Deutschland und der Schweizerischen Eidgenossenschaft über die gegenseitige Hilfeleistung bei Katastrophen und schweren Unglücksfällen v. 28. November 1984 (BGBl. 1987 II, p. 75) („German-Swiss Agreement"), Abkommen zwischen der Bundesrepublik Deutschland und der Republik Österreich über die gegenseitige Hilfeleistung bei Katastrophen und schweren Unglücksfällen v. 20. März 1992 („German- Austrian Agreement"), Abkommen zwischen der Bundesrepublik Deutschland und der Russischen Förderation über die gegenseitige Hilfeleistung bei

A study by the German Red Cross that was published in 2010 as a Country Report within the project "Analysis of Law in the EU Pertaining to Cross-Border Disaster Relief" provides a comprehensive overview of the laws and regulations as well as the operational practicalities in terms of transboundary disaster management from a German perspective[24]. The most important institutions will be summarized here.

Besides bilateral agreements of the federation, the states (Länder) also have the right to enter into agreements with other countries. According to Art. 32, paragraph 3 of the Basic Constitutional Law, the federal states can conclude agreements with foreign countries with consent of the federal government if the matter concerned by the agreement falls within their legislative power. Since this is the case regarding disaster relief, some of the federal states have concluded agreements with their neighbouring states or regions (German Red Cross, 2010, p. 7). Also, both official and unofficial agreements exist at the local level, e.g. between German municipalities and their direct neighbours[25].

Corresponding to this complex horizontal distribution of responsibilities, no exclusively responsible national focal point has been defined for requesting international disaster relief and liaising with international aid providers. Rather, various contact points exist whose responsibilities are determined according to the legal basis of the international request.

Regarding the operational process in terms of German assistance in foreign countries, the responsibility for humanitarian assistance (which from a German perspective refers to measures in third countries outside the EU) lies with the Federal Foreign Office (Auswärtiges Amt (AA))[26], while disaster relief and management within Germany (and in view of the cross-border disaster relief as regards the EU) the Federal Ministry for the Interior is the leading responsible portfolio. Regarding the CPM, the procedure starts with an international request for disaster relief within the framework of the CPM. If Germany is to assist, the situation centre (Lagezentrum) of the Federal Ministry of the Interior is contacted. The request is then passed on to and carried out by the German Joint Information and Situation Centre (GMLZ) of the Federal Office of Civil Protection and Disaster Assistance (BBK). The GMLZ communicates between the requesting state(s) and the potentially assisting organizations in Germany.

Since the procedures agreed upon bilaterally have precedence over the CPM, foreign countries that have concluded bilateral agreements with and seek disaster relief from Germany have to interact with the contact point or institution designated within the respective agreement (German Red Cross, 2010, p. 11). While this is typically the Federal Ministry of the Interior, requests can also be directed at the Ministries of the Interior of the federal state(s) that are located at the border to the requesting country, at the district president (Regierungspräsident) who has been authorized by the Ministry of the Interior of the respective federal state or can even be directly filed with the local fire brigades, the situation centers of the police departments or the authorities of the municipality. Annexes to agreements on the federal state or municipality level, often contain precise contact information.

By 2011, Germany has not officially requested assistance through CPM but contributed assistance 14 times between 2007 and 2011 alone.

Katastrophen und schweren Unglücksfällen v. 16.

[24] www.ifrc.org/Global/Publications/IDRL/country%20studies/IDRL-Report_GerRC_May2010.pdf

[25] e.g. the agreements on mutual assistance in cases of disasters between the City of Aachen and the Cities of Heerlen, Kelmis, Kerkraade and Vaals respectively

[26] In November 2011, the Federal Foreign Office and the Federal Ministry for Economic Cooperation and Development (BMZ) concluded an inter-ministerial agreement, redefining the government departments` responsibilities regarding humanitarian assistance (https://www.bmz.de/en/issues/transitional-development-assistance/index.html). The AA is now in charge of the government's entire portfolio of humanitarian aid; the BMZ is responsible for transitional development assistance.

Non-governmental organizations

German Committee for Disaster Reduction (DKKV)

With the beginning of the United Nations` International Decade for Natural Disaster Reduction (IDNDR) in 1990, the German IDNDR Committee was set up. After the decade`s end, the association German Committee for Disaster Reduction (Deutsches Komitee Katastrophenvorsorge e.V.; DKKV) was established as a non-governmental organization, non- profit association under private law and seamlessly took over the IDNDR`s tasks in 2000. The DKKV was designated by the German Government as National Platform (NP) for Disaster Risk Reduction (DRR) in the framework of the UNISDR (United Nations International Strategy for Disaster Reduction). In this function, DKKV served as the German focal point institution for the 10-year international disaster risk reduction plan, the Hyogo Framework for Action 2005-2015 (HFA). As such it promoted the implementation of the HFA which ended in 2015. The successor instrument to the HFA, the Sendai Framework for Disaster Risk Reduction 2015-2030, will be implemented and managed through governmental bodies (see section Implementing International DRR Frameworks in Germany) as recommended in the framework itself.

Since the end of the HFA, the DKKV mainly serves as a network and information hub for organizations and initiatives involved in DRR and as a centre of expertise in all matters relating to national and international disaster reduction issues. DKKV has available a consolidated network of key stakeholders within the disaster reduction domain at the national, European and international level, including European civil protection authorities. The network`s interdisciplinary and multi-sectoral character enables a broad and targeted dissemination of initiatives, knowledge and methodologies within the DRR community. Among the focus areas of DKKV is linking science and practice, linking national and international aspects and initiatives as well as linking public-sector and private-sector structures. Members of DKKV range from governmental agencies (including the BBK, the THW and the UBA), scientific institutes and organizations, media, humanitarian and development cooperation organizations.

Relief organisations

In Germany, non-governmental relief organisations are part of the so-called “Behörden und Organisationen mit Sicherheitsaufgaben” (BOS), i.e. authorities and organizations that perform security tasks (such as law enforcement, fire brigades, emergency medical services and other emergency and rescue services) in those cases when they provide assistance within civil protection. The German Federation, States (Länder) and municipalities are working together with the large relief organisations in a vertically structured emergency aid system. The following organizations belong are relevant for civil protection:

- Workers' Samaritan Federation Germany (German: Arbeiter-Samariter-Bund; ASB)
- German Lifeguard Association (German: Deutsche Lebens-Rettungs-Gesellschaft; DLRG))
- German Red Cross (German: Deutsches Rotes Kreuz; DRK)
- Hospitaller Emergency Service (German: Johanniter-Unfall-Hilfe e.V.)
- Auxiliary Service of the Order of Malta (German: Malteser-Hilfsdienst e.V.)
- Union of the German Fire Departments (German: Deutscher Feuerwehr Verband; DFV (The DFV represents the interests of the German fire brigades national-wide and abroad))

Through these organisations alone, around 500,000 supporters are put at the disposal of the civil protection system (Lange & Endreß, 2013, p. 18).

The role of volunteers in German DRR

The fact that the German civil protection system would not be functional without volunteers is without controversy. 1.7 million volunteers (from which around 1.2 million volunteers come from the fire brigades and another 76,000 from the THW (BMI 2012)) form the backbone of civil protection in Germany with almost 90 % of relief organizations’ staff consisting of volunteers (Hielscher and Nock, 2014). This is why demographic change (with a decrease in the overall population and an overall aging society) poses a major challenge for the future of the German civil protection system (Lange & Endreß, 2013, p. 19). Studies[27] on voluntarism in DRR in comparison with other fields show that civil protection is especially affected by this development. While fire brigades and THW have already lost substantial numbers of members within the last years, projections predict a decline in numbers of volunteers within DRR by nearly a quarter from 2006 to 2025 (Hielscher & Nock, 2014, p. 9). It is not clear, however, whether the number of 1.7 million volunteers is actually operational for civil protection needs. Surveys among relief organisations showed that most do not have concrete figures on their active and trained supporters (Lange & Endreß, 2013, p.18).

Since civil protection is dependent on volunteers like no other sub-system of the German internal security, the success in recruiting new supporters will be crucial for its future (Geier 2013: 21). As a result, a number of conferences, workshops and studies on this topic have been conducted from both governmental and non-governmental institutions active in DRR within the last years[28]. One of the objectives is to better integrate migrants, women and senior citizens into DRR institutions since they were found to be heavily underrepresented (BBK 2012a, 2012b, 2012c, 2012d).

Private Sector

Besides insurance companies, the private sector is involved in DRR first and foremost as operator of critical infrastructures, e.g. in the fields of energy and water supply, transportation, telecommunications and information technology. Critical infrastructures are especially vulnerable to hazardous events due to their interdependence and the associated cascading effects. The privatization of critical infrastructure in Germany began in the 1960s so that today 80 percent of the German critical infrastructure facilities (as in most other countries) are operated and owned by private or privatized enterprises (Schneider, 2014), which are thus also responsible for the functioning of the facilities. In cooperation between the Federal Ministry of the Interior, its subordinate authorities and CI operators, guidelines, protection concepts and PPPs have been established that have resulted in national legislation (see section German Laws on Flood Protection

The overall regulatory law for water management in Germany stipulates that water bodies are subject to state management. The most important federal law is the Federal Water Act (Wasserhaushaltsgesetz, WHG) which was originally adopted in 1957. The major flood in August 2002 induced legislative changes so that a substantially revised version entered into force in 2010 after transposition of the EU Water Framework Directive (WFD) into German national law. Regarding DRR, particularly the German Flood Protection Act of 2005 (Artikelgesetz zur Verbesserung des vorbeugenden Hochwasserschutzes) and the European Floods Directive (2007/60/EC; EC 2007) introduced important changes which marked a shift towards a more integrated flood-risk-management system in Germany that also considers non-structural measures to minimize adverse effects of flooding (DKKV, 2015b; Thieken et al., 2016; Hartmann and Albrecht 2014).

Furthermore, the EU Floods Directive requires that member states prepare flood hazard and risk maps for areas with (potentially) significant flood risk and establish flood risk management plans that outline plans for the implementation of prevention, protection and preparedness measures. Above all, the Floods Directive demands a review of such instruments in an iterative optimisation process. A thorough analysis of the flood in 2013 (DKKV, 2015b) shows that considerable improvements have been made on many levels that deal with flood risk reduction and disaster response in Germany, in particular in 1) increased consideration of flood hazards in spatial planning and development, 2) comprehensive private precaution and self-provision, 3) more effective early warning and improved coordination of disaster response and 4) a more targeted maintenance of flood defence systems.

However, implementation of the aforementioned changes to the WHG were still dominated by structural flood defences. It is rather after the flood in June 2013, that "bigger strategic changes are discernible. The systematic search and creation of retention space seen in the National Protection Program is one example of a further rejection of a purely protective concept, even if this is not always reflected in the terminology" (Thieken et al., 2016).

National Strategy to Protect Critical Infrastructure).

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[27] cf. Hielscher & Nock 2014; Krimmer & Priemer 2013

[28] e.g. the symposium „Ehrenamt im Bevölkerungsschutz" (DRK, 2012), the studies published by BBK (2012a, 2012b, 2012c, 2012d) or the research project „Professionelle Integration von freiwilligen Helfern in Krisenmanagement und Katastrophenschutz" (INKA) (BBE, 2015)

Since Critical Infrastructures are rather vulnerable industries due to their interconnectedness, the IPCC has argued in its Fourth Assessment Report on Climate Change (2007) that these need to adapt to climate change impacts such as extreme weather events, changing mean temperatures and precipitation patterns in order to prevent major damage or outages in the future. A case study of Germany`s critical infrastructure and CCA by Schneider (2014) shows that - in contrast to the publications of the BMUB and its agencies - the German CIP Strategy "does not differentiate between climate change impacts and other natural hazards and, therefore, does not account for climate change as a special societal issue [...]".

Legal Structures and Institutions in Relation to CCA in Germany

Since it is very unlikely that the negative impacts of climate change can still be avoided even by the most ambitious climate mitigation goals (IPCC, 2013), climate change adaptation (CCA) has gained increasing importance in debates about climate change within the last few years. Therefore, CCA processes have been initiated on international, European as well as national levels. On a European level, the EU strategy on adaptation to climate change has been adopted by the European Commission in April 2013 with one of the aims being to encourage Member States "to adopt comprehensive adaptation strategies" (European Commission, 2013).

Germany has taken a leading role in climate change mitigation and adaptation since the 1980s and adopted its Strategy for Adaptation to Climate Change (DAS) already in 2008, followed by the Adaptation Action Plan of the German Adaptation Strategy in 2011. A number of legislative frameworks regarding CCA have been adopted at the federal level while the majority of adaptation measures have to be taken at the level of federal states and municipalities. Both will be summarized in the following sections.

National Level: Relevant Institutions and Legislative Frameworks for CCA

Ministries and Agencies

3.1.0.0.1 Environment and transport portfolio

Government policies regarding climate protection and climate change adaptation fall mainly under portfolio of the Environment Ministry (BMUB) and its agencies: The Federal Environment Agency, the Federal Agency for Nature Conservation, the Federal Office for Radiation Protection and the Federal Office for Building and Regional Planning[29]. Out of these four the Federal Environment Agency (Umweltbundesamt (UBA)) and the Federal Office for Building and Regional Planning (Bundesamt für Bauwesen und Raumordnung (BBR)) are the agencies mostly involved with climate change issues. The German Strategy for Adaptation to Climate Change (see section 2.2.1.3) and subsequent framework documents were passed by the German government under the lead of the BMUB. The agencies and their functions will be described in more detail in the following.

3.1.0.0.2 Federal Environment Agency and Competence Centre for Climate Impacts and Adaptation

The competence centre for climate impacts and adaptation (Kompetenzzentrum Klimafolgen und Anpassung (KomPass)), based at the federal environment agency (Umweltbundesamt (UBA)), wants to link expertise on climate change effects and to convey this expertise to decision makers and the public. KomPass was set up at the end of 2006 and supported the development of the National Adaptation Strategy. It offers a wide range of tools in CCA that are described in detail below (see section **Errore. L'origine riferimento non è stata trovata.**).

[29]In December 2013, the Chancellor issued a decree transferring the responsibility for building (including urban development, housing, rural infrastructure, public building law, the construction industry and federal buildings) from the former Federal Ministry for Transport, Building and Urban Development (BMVBS) to the BMUB (BMUB, 2016).

3.1.0.0.3 Federal Institute for Research on Building, Urban Affairs and Spatial Development

The Federal Institute for Research on Building, Urban Affairs and Spatial Development (Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR)) within the Federal Office for Building and Regional Planning as a departmental research institution advises the Federal Government with sectoral scientific consultation in the policy fields of spatial planning, urban development, housing and building. The institute supervises several initiatives on climate change adaptation[30].

3.1.0.0.4 National Meteorological Service - Deutscher Wetterdienst

Germany's National Meteorological Service, the Deutscher Wetterdienst (DWD) as an agency under the remit of the Federal Ministry of Transport and Digital Infrastructure is responsible for meeting meteorological requirements arising from all areas of economy and society in Germany. The area of responsibility is defined by the statutory tasks of providing information and performing research as laid down in the Law on the Deutscher Wetterdienst (DWD 2015), among them:

- provision of meteorological services,
- meteorological safeguarding of aviation and shipping,
- issuing of official warnings about potentially dangerous weather phenomena,
- short and long-term recording, monitoring, and evaluation of meteorological processes in the atmosphere, its structure and composition,
- recording of interactions between the atmosphere and other environmental spheres,
- forecasting of meteorological processes,
- operation of the necessary measuring and observation systems, and
- provision, storage, and documentation of meteorological data and products.

A cooperation agreement between the BBK and the German Meteorological Service (Deutscher Wetterdienst; DWD) was established in 2008 to better integrate the services of the DWD into civil protection. Data on weather and climate are provided by the DWD which the BBK uses for risk mapping and analysis, especially with respect to the GLMZ and the warning of the population[31].

The German Strategy for Adaptation to Climate Change

The German Strategy for Adaptation to Climate Change (Deutsche Anpassungsstrategie an den Klimawandel (DAS) (Bundesregierung, 2008)) was established in 2008 as a framework for a medium-term national adaptation process:

“Even with a limited temperature rise of this magnitude, the environmental, social and economic consequences of the climate change that is already taking place will make their effects felt. If the 2°C target is met, it is expected to be possible to mitigate the consequences by means of appropriate and timely adaptation measures and thereby avoid serious consequences.” (Bundesregierung, 2008, p. 5)

The DAS was also a first step of the federal government in order to meet its obligations under Article 4 of the United Nations Framework Convention on Climate Change (UNFCCC). The DAS highlights areas likely to be affected by climate change or which already show evidence of impacts as well as requirements for action for

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[30] With the research programme “Experimental Housing and Urban Development” (Experimenteller Wohnungs- und Städtebau (ExWoSt)) the federation supports innovative planning and measures on climate change such as StadtKlimaExWoSt (Urban Strategies for Adapting to Climate Change). With the action programme "Demonstration Projects of Spatial Planning" (MORO) and especially the project “Raumentwicklungsstrategien zum Klimawandel“ (KlimaMORO) that is also supervised by the BBSR, the Federal Ministry of Transport and Digital Infrastructure (Bundesministerium für Verkehr und digitale Infrastruktur (BMVI)) supports practical trials and implementations of innovative action approaches and instruments for spatial planning in co-operation with science and practice.

[31] http://www.bevoelkerungsschutz-portal.de/BVS/DE/Zustaendigkeiten/DWD/dwd_node.html

adaptation in various sectors in 14 fields of action including so-called crosscutting issues of which civil protection is mentioned as one.

The aim of the strategy was to create a national framework for action in order to avert dangers to the public, the environment as well as the national economy. The framework was intended to make it easier for the various levels of the Federation, Länder, local authorities and for individual citizens to identify impacts and adaptation needs, and to plan and implement measures. The DAS was developed in close cooperation with the federal states by a working group comprised of representatives from most of the federal ministries and under the lead responsibility of the Federal Environment Ministry.

Adaptation Action Plan I and II

In 2011, the Adaptation Action Plan (Aktionsplan Anpassung (APA)) (Deutsche Bundesregierung, 2011) followed to supplement the strategy with concrete objectives and activities and to establish links to other national strategic processes. It was the result of an inter-departmental discussion and coordination process. The APA I is underpinned by the objectives and options for action, defining specific activities as detailed in the DAS and linking it with other national strategy processes. The APA mainly presented federal activities while also relating to joint activities with the federal states. According to the progress report of 2015, 43 of the 150 activities and measures that were defined in the APA I were finalized by the time the report was published. Another element of the Progress Report is an updated APA, the "Adaptation Action Plan II". This plan presents future actions of the federal government as well as a concrete time and financing plan.

All activities of APA II are organized along specific fields of action or clusters, e.g. “water”, “infrastructures”, “land”, “health”, “business” and “spatial planning and civil protection (Bevölkerungsschutz)”. The same clusters were also used in the vulnerability assessment (see section Vulnerability Network and Vulnerability Assessment for Germany) and are an agreed concept for CCA in Germany.

Indicator and Monitoring Reports

In September 2015, the first report to evaluate the DAS was published. According to the Federal Environmental Agency (UBA), the development of indicators “[...] underlying the Monitoring Report and the overall report itself were created and agreed politically in an inter-departmental process with the participation of numerous experts from the competent sectors of agencies at Federal and Länder level and from scientific and private institutions. This painstaking theme-specific process took nearly six years” (UBA, 2015c).

On the basis of defined indicators, the monitoring report was meant to describe the current state of development and implementation of climate change adaptation in Germany. In cooperation with federal and state authorities, NGOs, the private sector and science, the UBA developed a system of indicators for the 15 fields of action of the German Adaptation Strategy. These indicators demonstrate how Germany is affected by climate change and where adaptation measures have already been taken. The indicator system for the DAS is primarily an instrument of the federal state, which is meant to accompany the process of implementing the DAS.

In terms of DRR, the report states that data about the number, duration and causes of the THW’s operations show no significant trend towards a permanent increase in operational strain but that singular extreme events, especially recent record floodings, do have a significant impact on operations (UBA, 2015a, p.222).

Horizontal Cooperation

Interministerial Working Group on Adaptation to Climate Change

Led by the Federal Environment Ministry, the Interministerial Working Group on Adaptation to Climate Change (Interministerielle Arbeitsgruppe Anpassungsstrategie der Bundesregierung (IMA)), previously an informal working group, was formalised after the adoption of the DAS. Nearly all federal ministries are represented in the IMA[32] (UBA 2015a). The working group`s purpose is to coordinate the cooperation among the participating ministries and further develop the DAS. In 2015, the IMA submitted the first Monitoring Report on the German Strategy for Adaptation to Climate Change, summarizing climate change impacts and adaptation measures in Germany (UBA 2015a). This Monitoring Report is planned to be submitted every four years to track the further developments (ibid).

Vulnerability Network and Vulnerability Assessment for Germany

In the Adaptation Action Plan (APA) it was stated that "Germany needs an up-to-date cross-sectoral vulnerability assessment prepared in line with uniform standards". Such an interdisciplinary task required the cooperation of different research institutions and authorities as well as the integration of regional and action field-specific expertise. Therefore, in 2011 the "Vulnerability Network" was established by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and the German Environment Agency.

From 2011 to 2015 a network of 16 federal agencies and institutes supported by a scientific consortium, has assessed the vulnerability of Germany to climate change. The purpose was to prioritize the risks of climate change and the need for action at the federal level. For that purpose, existing regional and sectoral evaluations of climate change impacts and vulnerability studies were analyzed. Furthermore, a methodology for a new cross-sectoral, nation-wide standardized vulnerability assessment was being developed. Using the vulnerability methodology, an interdisciplinary screening procedure identified those regions and systems across Germany that are particularly threatened by climate change. The results were discussed at the conference "Germany's vulnerability to climate change" in June 2015 and published in November 2015 (UBA, 2015b).

The report does however not present any detailed results regarding the crosscutting issue of "Civil and disaster protection". It only states that: "It has not been possible to identify indicators that would allow us to come to any conclusions on civil protection's contribution to the adaptive capacity towards climate change over the entire country. This would require a nationwide uniform data collection exercise that would have to include a cross-organisational approach. Since, however, civil protection has high overall standards, it can be expected that it is prepared for the challenges of climate change adaptation" (ibid: 45).

Vertical Cooperation

Standing committee for the adaptation to climate change impacts

As part of the federal government's and federal states` working group on climate, energy, mobility and sustainability (Bund-Länder-Arbeitsgemeinschaft Klima, Energie, Mobilität und Nachhaltigkeit (BLAG KliNa)), in 2009, the Conference of Environmental Ministers (UMK) established a standing committee for the adaptation to climate change impacts (Ständiger Ausschuss zur Anpassung an die Folgen des Klimawandels (StA AFK)). The committee's task is to provide information to the federal government and the federal states and coordinate and link their respective climate adaptation activities in an interadministrative cooperation. One of the committee`s main tasks was the development of the APAs together with the IMA (BLAG KLINa, 2012).

Expert discussions on climate change impacts and adaptation (Fachgespräche Klimafolgen)

The expert discussions on climate change impacts and adaptation (Fachgespräche Klimafolgen) are a cooperation between federal state authorities and the Federal Environment Agency (UBA). The discussions are focussing on information exchange regarding running projects on climate change issues. The UBA is

[32] Auswärtiges Amt (AA), Bundeskanzleramt (BK), Bundesministerium der Finanzen (BMF), Bundesministerium des Innern (BMI), Bundesministerium für Arbeit und Soziales (BMAS), Bundesministerium für Bildung und Forschung (BMBF), Bundesministerium für Ernährung und Landwirtschaft (BMEL), Bundesministerium der Verteidigung (BMVg), Bundesministerium für Familie, Senioren, Frauen und Jugend (BMFSFJ), Bundesministerium für Gesundheit (BMG), Bundesministerium für Verkehr und digitale Infrastruktur (BMVI), Bundesministerium für Wirtschaft und Energie (BMWi), Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ). Ständig beisitzende Oberbehörde ist das Umweltbundesamt (UBA).

coordinating the interstate discussions to identify mandatory political tasks around climate change issues and improve and ensure data provision as well as enable technical cooperation and exchange of information to support political actors and institutions such as the Conference of Environmental Ministers of the Länder (Umweltministerkonferenz; UMK).

Legislative Integration of Climate Change Adaptation

Since law as an instrument for steering the actions of individuals and institutions plays a central role for adaptation policies, integrating CCA into federal legislation (i.e. climate mainstreaming) is essential for progress on this matter. Accordingly, the Adaptation Action Plan I (2011) elaborates on the way forward regarding the inclusion of climate related issues into federal legislation:

"The federal ministries are called upon to examine whether it is objectively necessary and appropriate to include climate change impacts or adaptation requirements as target, principle or even trade-off aspect in relevant legislation that is being introduced, particularly in the fields of planning and environmental law" (APA, 2011, p.29f).

In a study on climate mainstreaming in federal legislation Bubeck et al. (2016) evaluate the degree and effects of legislative climate mainstreaming in Germany. The authors come to the conclusion that CCA has only been explicitly integrated into very few laws, i.e. the Federal Regional Planning Act (Raumordnungsgesetz (ROG)), the Federal Building Code (Baugesetzbuch (BauGB)) and the Federal Water Resources Act (Wasserhaushaltsgesetz (WHG)). The authors however remark that these are very relevant legislations for CCA.

When the Federal Regional Planning Act was revised in 2008, adaptation to climate change was introduced into the legislation as one of the principles of spatial planning (Paragraph 2, Section 2, No. 6) (APA, 2011, p.29f) but when looking at the actual implementation, climate change issues are integrated rather selectively. There is quite a regional variation, with CCA issues being especially considered within pioneering pilot regions (e.g. within the KlimaMORO initiatives.

Generally, Bubeck et al. conclude that the lack of clear objectives and thresholds in CCA (as they exist for climate protection) is a barrier for implementing CCA on the ground. Defining these for the adaptation to climate change is however more complicated due to the greater dependence on context and location (Bubeck et al., 2016, p. 303). The gaps and barriers regarding the integration of CCA and DRR into legislative frameworks will be discussed further in section 4.1.4).

Another result of the German Adaptation Strategy was the development of rules related to Natech (Natural Hazard Triggering Technological Disasters) risks by the Commission on Process Safety (Kommission für Anlagensicherheit (KAS)). The KAS developed two Technical Rules on Installation Safety (Technische Regeln für Anlagensicherheit (TRAS)) that take into account the effects of Climate Change (Krausmann,Cruz & Salzano, 2016, p.60):

On the basis of Article 51a of the German Federal Immission Control Act, the BMUB promulgated

- TRAS 310 "Precautions and Measures against the Hazard Sources Precipitation and Flooding"[33]and the
- TRAS 320 "Precautions and Measures against the Hazard Sources Wind, Snow- and Iceloads"[34].

These Technical Rules on Installation Safety (TRAS) apply to implementing the obligations of the Major Accidents Ordinance as well as the EU Seveso-Directive (Krausmann et al., 2016, p.60).

Both TRAS introduce the same systematic approach for Natech Risk Management by operators related to the natural hazards within their scope. They include a short characterization of the relevant hazards and offer

[33] http://www.kas-bmu.de/publikationen/tras/TRAS_310end.pdf
[34] http://www.kas-bmu.de/publikationen/tras/tras_320.pdf

recommendations for a simplified and detailed hazard source analysis, the determination of safety relevant parts of installations that may be at risk, specification of protection aims, elaboration of protection concepts, measures for mitigation, and emergency management. The chapters on the characterization of the relevant natural hazards include some information about the expected effects of climate change in Germany on these natural hazards (as known by the time of publication). The parts on hazard source analysis include the recommendation to consider effects of climate change in this analysis. The specification of protection aims considers climate change in some aspects.

The TRAS 310 requires operators to consider climate change by the application of a "climate change factor" of 1.2 (a) on the 100-year runoff of riverine systems and (b) on the 100-year precipitation rate. New installations and installations to be operated until 2050 or later have to comply with this requirement.

The TRAS 320 introduces no "climate change factor" as there was no reliable knowledge on the effects of climate change on top speeds of winter storms, snow- and iceloads in Germany by the time of elaboration of the rule. Nevertheless, the TRAS 320 includes the requirement for operators to consider data on extreme snow loads in the lay-out of their installations (before this was required in the north of Germany only and has been extended to the whole country by the TRAS). This requirement considers possible present effects of climate change on extreme snowfall events. For both TRAS recommendations and explanations as well as background information are available.

Krausmann et al. (2016, p.) suggest that TRAS 310 "may be one of the first technical rules considering the expected consequences of climate change. This was possible due to enormous work carried out in Germany, especially on projections of climate change at the regional level". Moreover, the TRAS 310 will be evaluated every five years in terms of needed updates in order to be able to integrate new research results regarding climate change impacts (Bundesregierung, 2015, p.21).

The German water legislation which was updated in 2010 as a result of the EU Floods Directive also foresees an update of hazards and risk maps as well as of management plans every six years because of climate change (see also section German Laws on Flood Protection).

Implementing CCA at local level

Municipalities are among the central actors when looking at CCA since many of the impacts of climate change become effective on the local level. Despite that, integrating adaptation measures into urban and spatial planning is still in its infancy.

The report on progress in implementing the German Adaptation Strategy DAS includes an evaluation of regional pilot projects on climate change adaptation (Bundesregierung, 2015, p.26f). The results suggest that a number of climate change relevant measures are taken that are not explicitly termed as such (e.g. flood protection, green areas, avoiding conventional pavement (sealing) by asphalt, concrete or closed stone areas). The report also points out that smaller municipalities do not necessarily have the financial and human capacities to initiate proper adaptation measures[35] which is further complicated by the fact that there is no ideal adaptation process in terms of „one size fits all" when looking at regional and local levels since the underlying conditions and parameters are so diverse. However, guidelines based on best practices should be created and communicated. In some fields like flood protection and coastal management such examples have been systematically collected and published with a special focus on municipalities and local actors. The evaluation nevertheless showed that climate change adaptation in regional and urban planning often remains within the scope of pilot projects while playing a minor role in practice. This is underlined by the vulnerability assessment`s results: "Actual local-level adaptation activities are generally rather sparse and concentrate on a few urban centres. For this reason, according to the Vulnerability Network estimate, increased technical and financial support is needed in particular in small and medium municipalities" (UBA, 2015b).

[35] This is supported by recent findings such as the master thesis of Dierck (2016)

CCA Platforms and Tools

Quite a number of different tools and guidelines regarding climate change adaptation on different administrative levels have been developed within the last years. A comprehensive and systematic overview of tools and guidelines for the German context can be found in Gebhardt et al. (2017). In the following, only a selection can be presented.

Among the most relevant CCA services provided by the scientific community is the Helmholtz Association (Helmholtz-Gemeinschaft) of German Research Centres and its Climate Service Center Germany (GERICS).

Climate Service Center Germany (GERICS)

GERICS was initiated by the German Federal Government[36] in 2009 as a fundamental part of the German hightech-strategy for climate protection. In June 2014, GERICS has become a scientific organizational entity of the Helmholtz-Zentrum Geesthacht. It functions as a think tank for climate services and develops prototype products in cooperation with science and practice partners from politics, economy and administration. Two of these tools (Adaptation toolkit for cities (Stadtbaukasten) and Klimanavigator) are described in the info box below.

On a governmental level, the following two organisations have been or are planned to be established to institutionalize the needed services for the implementation of the German Strategy for Adaption to Climate Change:

Deutscher Klimadienst

The Deutscher Klimadienst (DKD) is Germany's network of agencies and offices[37] which, on a regular, operational basis, is to provide reliable long-term climate information and climate services. The Deutscher Klimadienst (DKD) was officially launched in October 2015. The DKD`s task is to ensure that climate information and climate services at the national level are scientifically sound, tailored to the users' needs, coherent and reliable, while duplication of work is to be avoided to make best use of existing resources.

Klimadapt (planned)

A similar structure with the DKD is planned that provides information and recommendations regarding adaptation measures on the basis of DKD`s climate information together with other parameters. KlimAdapt[38] together with the DKD are supposed to form a comprehensive two-pillar model that represents the overall climate services of the federation[39]. KlimAdapt marks the transition of project-based CCA support to an institutionalized format.
A selection of other climate services is listed in the info box below.

Tools of „KomPass - Climate Impacts and Adaptation in Germany"

- **Climate Navigator**
  (https://www.umweltbundesamt.de/en/node/8674)
  The Climate Navigator ("Klimalotse") supports decision makers in developing their own strategy for climate change adaptation. It is tailored to the information needs of local authorities as well as companies. The platform contains specific information and examples for both target groups and does not require any prior knowledge. The Climate Navigator is guiding users in detail through the process of integrating adaptation measures into existing instruments and involving stakeholders. Adaptation measures are divided into short, medium and long term planning and responsibilities, communication methods, synergies and

[36] Jointly by BMBF, BMU and BMVi
[37] Led by BMVi, the DKD`s Secretariat is based at the DWD
[38] Led by the BMUB, the KlimAdapt`s Secretariat is planned to be based at the UBA / KomPass
[39] Further information and an organigram can be found at: http://www.deutscheskli maportal.de/DE/Themen/4_DKD/DKD.html

conflicts are described for each measure. The Climate Navigator is in German language; a short version is available in English.

- **Tatenbank**
  (https://www.umweltbundesamt.de/themen/klima-energie/klimafolgen-anpassung/werkzeuge-der-anpassung/tatenbank)
  The "Tatenbank" (deeds bank) introduces exemplary adaptation measures of different stakeholders. It provides all interested parties with a forum for an independent registration of adaptation projects and to receive suggestions for effective action. The database focuses on local and regional measures that have already been carried out or are currently being implemented in Germany. The filter allows for displaying those which somehow relate to civil protection or, more general, DRR. The Tatenbank is only available in German language.

- **Project Catalogue**
  https://www.umweltbundesamt.de/en/topics/climate-energy/climate-change-adaptation/adaptation-tools/project-catalog
  An extensive project catalogue regarding climate change impacts and adaptation documents scientific projects in Germany and Central Europe, which generate basic knowledge on climate change adaptation. It informs stakeholders from research and research sponsors by collecting existing knowledge about climate impacts and adaptation. The Project Catalogue is available in German and English.

- **Klimanavigator**
  www.klimanavigator.de
  The web portal contains portraits of German academic institutions working on issues of climate change and provides an overview of their key research areas. A multifunctional search makes it easy to find institutions and their specific areas of expertise.

Tools for municipalities

- **Stadtklimalotse:**
  http://www.stadtklimalotse.net/
  The research programme KlimaExWoSt developed the Stadtklimalotse (city climate guide), a tool that supports medium-sized and smaller municipalities in their decision-making processes. It enables municipalities to assess their own concern in ten fields of action. The core of the tool is a data base that contains approximately 140 adaptation measures that intend to support the user when selecting appropriate, context-specific measures. The Stadtklimalotse is in German language.

- **Climate Scout**
  http://www.klimascout.de/
  The Climate Scout is run by the Climate Alliance and accompanies municipalities and communities in the development of a suitable adaptation strategy. The platform is designed in form of an Internet encyclopaedia and is divided into four modules. It provides incentives for the development of own solutions. The Climate Scout is in German language.

- **Adaptation Compass:**
  http://www.future-cities.eu/project/adaptation-compass/
  The adaptation tool was developed in the context of the European cooperation project "Future Cities". With the help of a workbook and numerous interlinked documents, it provides employees of local authorities with information enabling them to determine their own issues and identify cross-sectoral adaptation measures. The Project Catalogue is available in German and English.

- **Adaptation toolkit for cities (Stadtbaukasten)**
  http://www.climate-service-center.de/products_and_publications/toolkits/stadtbaukasten/index.php.en
  In contrast to web portals and other best-practice solutions that can be found on the web, all activities in the *Stadtbaukasten* are done in close cooperation between city representatives and the Climate Service Center Germany (GERICS). This is supposed to support the development of customized solutions according to the local situation on a case-by-case basis[40].

Science Approaches, Institutions and Programmes on Disaster Risk Reduction and Climate Change Adaptation in Germany

Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) have a closely intertwined trajectory in research. This can be effectively observed in Annex 2, where several research projects and publications address both DRR and CCA related issues. Additionally, both domains are not isolated from each other; the effects of Climate Change can potentially have a significant impact on the risks faced by the population, on multiple levels (Venton & La Trobe, 2008). This synergy found between DRR and CCA calls for joint efforts capable of providing a systemic perspective, instead of compartmentalized research.

Qualitative and Quantitative Research Methods

The concept of qualitative and quantitative research is frequently used throughout this document, hence, it's important to clarify what these concepts mean, and how they are used in this context.

Given the complexity of the concept, this document adopts a division between both concepts considering the type of data used (Given, 2008). According to this division, **Qualitative Methods** are a type of scientific research concerned with understanding unstructured descriptive data, normally not in numerical form. These methods are mainly exploratory, and frequently rely on expert's knowledge to interpret the available data.

Quantitative Methods, on the other hand, are those interested in numerical data susceptible of measurement or order. These methods are approached through statistical, mathematical or computational techniques.

In the context of this work, examples of qualitative methods are interviews, case studies, and thematic analysis, among others. Examples of quantitative research are computational simulation, clustering analysis and other computational or mathematical techniques.

From a general perspective, this report focuses on three fundamental aspects whose description may help characterizing the scientific research in Germany: funding institutions, research centres and scientific methodologies frequently used to address research challenges in relation to CCA and DRR.

Funding institutions contribute not only by financial resources, but also shape the horizon regarding research directions and interests through exhaustive selection processes and open calls for specific topics. While Germany offers a wide range of financial support possibilities both for individual applicants and research projects, the economic source can usually be traced to a few, mostly public, entities which are the focus of this report. It is also worth noting that Germany is the European country with the highest expenditure on research and development and ranked fourth in the world after USA, China and Japan (DFG, 2015).

[40] For a detailed description of the scientific background and the content of the Stadtbaukasten, cf. Cortekar et al., 2016

Germany has also a strong presence and support of well-known research centers, providing the structural capital required for conducting quality research on multiple fields, as described in the next sections for each domain. On a general basis, the organization of research in Germany, can be briefly summarized as in the following five pillars:

Higher Education Institutions (Universities): Not only preparing students for a potential research career, but also with a broad offer of research opportunities. Funding for these institutions comes mainly from state level and the DFG (on a project level and after a review process of proposals).

Max-Planck Association: Highly specialized institutes dedicated on fundamental research topics, such as meteorology in the Max-Planck Institute in Hamburg. This Association is equally funded by the Federal Government and the States.

Fraunhofer Association: Association of institutes dedicated on applied research. Given its strong cooperation with industry partners, their funding comes mainly from contract research (70%) and the rest from public sources.

Helmholtz Association: Research on big societal challenges. This association is jointly funded by the Federal Government (BMBF) and the respective state (small share). Examples of institutes in this association dealing with earth-related research are GFZ, UFZ, DLR and others.

Institutes of the Leibniz-Association: Smaller research institutions on dedicated topics. This association is equally funded by the federal level (BMBF) and the respective state.

While the research in Germany is normally presented on a 4-pillar basis (without considering higher education institutions), this 5-pillar structure makes clear the focus on research of the remaining institutions, without study plans concerns.

Regarding scientific methodologies, there is a clear difference between the approaches adopted by Disaster Risk Reduction and Climate Change Adaptation. The next sections expand on this difference, based on the compilation and analysis of several German research projects, whose description can be found in Annex 2.

Research Support Institutions and Scientific Approaches in Relation to Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA)

Both DRR and CCA research in Germany find economic support from multiple institutions. The main contributor is the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung (BMBF)) with a budget for institutionalized research of almost 6 billion Euro[41]. While funding individual researchers directly is explicitly excluded from the responsibilities of the BMBF[42], it still does so in cooperation with other institutions, being two of the most renowned the German Academic Exchange Service (Deutscher Akademischer Austauschdienst (DAAD))[43] and the Alexander von Humboldt Foundation[44]. In addition to several satellite programs, the BMBF has two main programs in place for DRR and CCA. The Framework Programme "Research for Civil Security 2012-2017" (Forschung für die zivile Sicherheit) (BMBF, 2012a) is the reference programme that the BMBF has in place for funding research in association with Disaster Risk Reduction issues. Regarding Climate Change Adaptation, the Framework Programme "Research for Sustainable Development" (Forschung für Nachhaltige Entwicklung (FONA)) is the most representative programme addressing Climate Change related issues with funding from the BMBF (BMBF, 2016).

Other financial support institutions for DRR and CCA are the German Research Foundation (Deutsche Forschungsgemeinschaft (DFG)), the largest European organization for funding research, and the Federal

[41] https://www.bmbf.de/en/education-and-research-priority-areas-of-federal-government-policy-1410.html
[42] https://www.bmbf.de/en/research-funding-1411.html
[43] https://www.bmbf.de/de/deutscher-akademischer-austauschdienst-daad-427.html
[44] https://www.bmbf.de/de/die-alexander-von-humboldt-stiftung-426.html

Foreign Office (Auswärtiges Amt (AA))[45]. The DFG provides economic resources through a variety of grant and funding programmes for scientists in Germany, with a budget of approximately 3 billion Euro annually[46]. On the other hand, the AA aims to improve the quality of Germany's research mainly through international cooperation and scientific exchange support.

Research Centres with equally shared interests on both DRR and CCA are not so common. Although some scientific institutions approach both topics, they frequently specialize on a single topic, keeping the other as support of the main research interest. Exceptions to this are major research centres, such as the institutes of the Helmholtz Association, such as for the Centre for Materials and Coastal Research (Helmholtz-Zentrum Geesthacht (HZG))[47], the Helmholtz Centre for Environmental Research (Helmholtz-Zentrum für Umweltforschung(UFZ)) [48], the German Research Centre for Geosciences (GeoForschungsZentrum (GFZ))[49], the Jülich Research Centre (Forschungszentrum Jülich (FZJ))[50], The Karlsruhe Institute of Technology (KIT)[51], the Alfred Wegener Institute for Polar and Marine Research (AWI)[52]; the Helmholtz Centre for Ocean Research Kiel (GEOMAR)[53] and the German Aerospace Centre (Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR))[54], having competence on multiple domains, including CCA and DRR. In the case of DLR, research adopts a highly technological perspective involving mainly applied science. in the case of Geosciences (GFZ Potsdam) and Environmental Research (UFZ Leipzig), these institutes follow lines of integrated research in special fields within their five-year programmes of research (POF).

Research Support Institutions and Scientific Approaches in Relation to Disaster Risk Reduction

Scientific knowledge plays a pivotal role in Disaster Risk Reduction, geared at presenting accurate, unbiased insights on catastrophes, and the development of new technology for preventing or mitigating the impacts of such catastrophes[55]. Furthermore, the Sendai Framework on Disaster Risk Reduction 2015-2030 (SFDRR) explicitly recognizes the relevance of science-based methodologies for Disaster Risk Reduction, and sets the goal of strengthening these approaches in the upcoming years (UNISDR, 2015).

Germany has a well-established network of public institutions that financially support research in Disaster Risk Reduction. Adding to the institutions presented in the previous section, a notable institution for research support in this area is the Federal Office for Population Protection and Disaster Aid (*Bundesamt für Bevölkerungsschutz und Katastrophenhilfe* - BBK), with influence on strategic research and development issues on population protection and the Federal Office for Environment (Umweltbundesamt) with a focus on risks to the environment and society at large (e.g. socio-economic risks)[56]. This funding is distributed between institutions of higher education and research centres (funded by the BMBF and DFG and the responsible state), with funding from the responsible ministry also assigned to research in the federal agencies, in very targeted research for problematics related to the ministries ("Ressortfoschung").

Most Research Centers for DRR are strategically placed in institutions of higher education, ensuring, in this way, a valuable supply of scientists in the field. Without constituting an exhaustive list, some noteworthy examples

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[45] http://www.auswaertiges-amt.de/EN/Startseite_node.html
[46] http://www.dfg.de/en/dfg_profile/facts_figures/statistics/finances/index.jsp
[47] https://www.hzg.de/index.php.de
[48] http://www.ufz.de/index.php?en=33573
[49] http://www.gfz-potsdam.de/en/home/
[50] http://www.fz-juelich.de/portal/EN/Home/home_node.html
[51] https://www.kit.edu/english/index.php
[52] https://www.awi.de/en.html
[53] http://www.geomar.de/en/
[54] http://www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10002/
[55] https://twas.org/article/increasing-role-science-natural-disaster-management
[56] http://www.bbk.bund.de/DE/AufgabenundAusstattung/Forschung/Forschung_node.html

frequently showing up in scientific literature and expert interviews should be mentioned[57]. The Free University of Berlin (*Freie Universität Berlin*) hosts the Disaster Research Unit (Katastrophenforschungsstelle (KFS))[58], a renowned institution specialising in interdisciplinary disaster research, and the Interdisciplinary Security Research Working Group (AG Interdisziplinäre Sicherheitsforschung)[59], a very prolific group with several high-profile projects in the field of DRR. Other well-known research centers are the Center for Disaster Management and Risk Reduction Technology[60] (CEDIM) part of the Karlsruhe Institute of Technology (jointly funded with GFZ Potsdam), the Institute of Rescue Engineering and Civil Protection[61] (Institut für Rettungsingenieurwesen und Gefahrenabwehr) from the Cologne University of Applied Sciences and the German Center for Geosciences (GFZ) from the Helmholtz Association, with significant presence on the DRR research landscape, holding a high citation/papers ratio on Disaster Management topics in Germany, with particular focus on flood-related research, as well as seismic risk and Tsunamis, as can be seen in Annex 3. X The University of Bonn, with the Master of Disaster Management and Risk Governance (Masterstudiengang Katastrophenvorsorge und Katastrophenmanagement (KaVoMa))[62], the United Nations University, in particular with the Institute for Environment and Human Security (UNU- EHS)[63], and the University of Potsdam, with the Research Training Group NatRiskChange (Natural Hazards and Risk in a Changing World)[64], have also a strong presence in the DRR landscape in Germany.

With respect to research methodologies, and given the relevance of social factors present in almost any disaster; DRR-associated research evolved to present standard approaches characterized by a combination of quantitative methodologies, mainly related to natural sciences with qualitative methodologies arising from a sufficient, yet not strong, presence of social sciences and psychology. A review exclusively on DRR research (projects used as source can be found in the first part of Annex 7.2) showed that expert interviews, scenario analysis, indicators development and questionnaires are some of the qualitative techniques most commonly seen in research projects in this field. Other hard-science associated approaches are certainly used too, with a strong emphasis on technical solutions to concrete problems, with a strong presence of engineering departments in higher education institutions in several cities across Germany, such as Hanover, Brunswig (Braunschweig), Munich, Karlsruhe, Aachen and Hamburg, among several others. Examples of these solutions are mainly on the field of Communications, Geographical Information Systems and Remote Sensing Technologies. The usage of past data was also present and in the form of case studies and content analysis mainly. High level simulations are also frequent in DRR research, mainly for scenario analysis, what-if's studies and other qualitative techniques. Quantitative data analysis, while present, was not the most seen approach in this field.

Research Support Institutions and Scientific Approaches in Relation to Climate Change Adaptation

On a national level, and besides the funding institutions already mentioned in section 3.3.1, such as the Ministry of Education and Research (BMBF) with the FONA3 Programme, other relevant sources of funding are the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMUB))[65] (see Info Box), the Hans Ertel Center for Weather Research (Hans-Ertel-Zentrum für Wetterforschung (HErZ))[66] and the Federal Ministry

[57] Details on the reviewed literature and projects considered in this report can be found in the Annex section.
[58] http://www.polsoz.fu-berlin.de/en/ethnologie/forschung/arbeitsstellen/katastrophenforschung/index.html
[59] http://www.sicherheit-forschung.de/index.html
[60] https://www.cedim.de/
[61] https://www.th-koeln.de/anlagen-energie-und-maschinensysteme
[62] https://www.kavoma.de/
[63] https://ehs.unu.edu/
[64] http://www.uni-potsdam.de/natriskchange/
[65] http://www.bmub.bund.de/ministerium
[66] https://www.herz-tb4.uni-bonn.de/index.php/hans-ertel-centre-for-weather-research

for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ))[67].

Due to the transnational nature of Climate Change Research, funding for this topic can also be found from international institutions and programmes, such as the Framework Programmes for Research and Technological Development from the European Commission, being the "Horizon 2020" its latest iteration[68].

In the field of CCA, "Ressortforschung" is also present as in the case of DRR. Several governmental agencies, both at national and federal levels, have direct involvement in research, such as the German Federal Institute of Hydrology[69] (Bundesanstalt für Gewässerkunde (BfG)), the Federal Maritime and Hydrographic Agency[70] (Bundesamt für Seeschifffahrt und Hydrographie (BSH)) or the National Meteorological Service[71] (Deutscher Wetterdienst (DWD)), among others[72].

Environment Department`s Research Plan 2017

The BMUB's latest departmental research plan (BMUB 2017) outlines the key research areas that the ministry will cover in 2017. Besides the establishment of the KlimAdapt Platform (see section 0), the department`s priorities in terms of CCA are among others the vulnerability assessment 2021, operationalizing the indicators of the German Adaptation Strategy (DAS) with remote sensing data, institutionalizing best practices in CCA through standardization processes and supporting municipalities and regions with controlled settlement contraction in particularly affected or endangered areas.

The Helmholtz Association (Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF)) has also a strong presence in Climate Research in Germany, with among others the GERICS Climate Service Center[73], a think-tank for innovation on Climate Science, and the "Climate Service Science" Institute[74] in cooperation with the University of Hamburg, complementing research tasks of the former.

It's not uncommon to observe strategical cooperation and alliances between renown research centers in Germany. The Cluster of Excellence "Integrated Climate System Analysis and Prediction", for example, reunites around 250 scientists from Hamburg University, The Max Planck Institute for Meteorology, the Institute for Coastal Research at the Helmholtz-Zentrum Geesthacht, and the German Climate Computing Centre (DKRZ)[75].

Regarding common research methodologies and unlike Disaster Risk Reduction, a review on Climate Change Adaptation research, shows that CCA frequently deals with past data mainly through quantitative analysis. The development of numerical models and methods is a key element of this research, characterized by high volumes of numeric data, sometimes spanning hundreds of years of measured variables. The development of technologies is mostly observed for environmental impact mitigation and more accurate measurement of variables, it does not constitute, however, the main research of this domain. Research on social and legal aspects is also present, although not a pivotal attribute of CCA research, focusing mainly on optimal policies for impact mitigation and societal behavioural changes. Another common aim of Climate Change research is "Vulnerability Assessment" as shown on the website for European Climate Adaptation Platform concerning

[67]https://www.bmz.de/en
[68]https://ec.europa.eu/programmes/horizon2020/
[69]http://www.bafg.de/EN/Home/homepage_en_node.html
[70]http://www.bsh.de/en/index.jsp
[71]http://www.dwd.de/EN/Home/home_node.html
[72]Information taken from the projects described in the German Climate Change Adaptation Strategy, found in http://climate-adapt.eea.europa.eu/countries-regions/countries/germany
[73]http://www.climate-service-center.de/
[74]http://www.climate-service-center.de/science/hicss/index.php.en
[75] https://www.uni-hamburg.de/forschung/forschungsprofil/exzellenzcluster/clisap.html

selected research[76]. This last methodology provides a common ground with Disaster Risk Reduction research, potentially bridging the division between domains.

Interdisciplinary approaches

Throughout the analysed scientific papers and project descriptions, a consistency is found in the usage of the word "interdisciplinary", understood as a broad coverage of multiple knowledge fields or domains, normally combining soft and hard sciences for an improved holistic understanding of the analysed situation. In this context, interdisciplinarity is introduced as a key element to deal with complex issues that could not be addressed by only one single knowledge domain.

The concept of interdisciplinary research is not only relevant from the scientific perspective, but also from the stakeholder's perspective, being frequently pushed by governmental funding agencies. The preface in the BMBF's Framework Programme for Civil Security (BMBF, 2012a) from the Federal Minister for Education and Research, Prof. Dr. Johanna Wanka, links interdisciplinarity with the perspectives from multiple stakeholders in research, business and industry. Furthermore, the importance of interdisciplinary research is implicitly made clear throughout the document, and explicitly frames Civil Security as an interdisciplinary and transdisciplinary issue, being the former defined as the integration of efforts from different disciplines, and the later as efforts creating a unity of intellectual frameworks beyond the disciplinary perspectives (Stember, 1991). Another relevant example of how this push strategy is implemented from governmental agencies is the Excellence Initiative from the German Research Foundation (DFG). This Initiative adopts a strong focus on interdisciplinarity through the promotion of Clusters of Excellence, an interdisciplinary network of research centres and graduate education institutions.

Legal and policy approaches combining CCA & DRR

The need to harmonize CCA and DRR activities in order to guarantee a functioning civil protection system under changing conditions - especially with regard to increased extreme weather events - has been identified by the relevant agencies several years ago:

The working group "Klimawandel und Anpassung im Katastrophenschutz" ("climate change and adaptation in disaster control") was founded in 2008. The working group includes a wide range of institutions active in DRR in Germany, among these the federal level of relief organizations (ASB, DLRG, DRK, JUH, MHD), the Federal Agency for Technical Relief (THW), fire brigades and the BBK (BBK, 2016, p.10f).

Also, the German Strategy for Adaptation to Climate Change deals with the relation of CCA and DRR. Under the heading "Cross-sectional topics: Spatial, regional and physical development planning and civil protection" it states that:

> *"Civil protection has only recently started to address the topic of climate change, which means that there has so far been little investigation on the possible impacts of climate change on this sector. Essentially, civil protection is already geared to deal with extreme events and major damage situations. If weather and climate-induced disasters occur more frequently in future, this can present state-managed civil protection with new challenges relating to its resources, crisis and emergency management and operations planning. At the same time these challenges have impacts on the individual protection and self-help measures of the general public. In the centre of attention is the future frequency and intensity of extreme events such as storms and floods, which threaten human life and cause heavy losses and damages"* (DAS 2008: 42).

The Federal Office of Civil Protection and Disaster Assistance (BBK) has put quite some effort into the topic according to their own statement: "The topic has been worked on in the BBK for about ten years now by a full-

[76] http://climate-adapt.eea.europa.eu/countries-regions/countries/germany

time employed staff position. Additionally, the BBK has been involved in the funding of research activities in the framework of the so-called Behördenallianz. The research projects carried out jointly with other federal institutions aimed at broadening the information basis specifically with respect to the potential developments of extreme weather events" (interview BBK, 13th January 2017).

This "Strategische Behördenallianz", i.e. a Strategic Governmental Agencies Alliance for adaptation to climate change, exists since June 2007. Members of the alliance include the Federal Agency for Technical Relief (THW), the Deutscher Wetterdienst (Germany's National Meteorological Service (DWD)), the Bundesinstitut für Bau-, Stadt- und Raumforschung (Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR)) and the Umweltbundesamt (Federal Environmental Agency (UBA). The alliance is also motivated by the fact that civil protection was defined as an important crosscutting issue in both, the Deutsche Anpassungsstrategie an den Klimawandel (DAS) of 2008 and the Aktionsplan Anpassung (APA) of 2011. The agencies closely cooperate within the alliance with joint preparation of events such as workshops and seminars, regular exchange of information as well as jointly conducted research (DKKV, 2015a: 13).

The Behördenallianz supports the federal ministries in identifying and implementing strategies, instruments and measures for reducing vulnerability to climate change effects. The main aim is to cooperate towards an improved approach in dealing with the effects of climate change, especially regarding extreme weather events - from long-term strategic planning to short-term operative measures. Therefore, the alliance has implemented various joint projects, e.g. on extremes in temperature, wind and precipitation.

Analysis of Challenges and Gaps in Disaster Risk Reduction and Climate Change Adaptation in Germany

After describing the status quo of the institutional set-up regarding CCA and DRR in Germany, the following sections will analyze the challenges and gaps that result from the literature review and interviews. These are described according to the categories defined within the conceptual framework.

Challenges and Gaps: Governance

Institutional Barriers and Stakeholder Complexity

As mentioned earlier, the German governmental system in general is federally organized and follows the department(al) principle ("Ressortprinzip") which means that - within the boundaries set by the Chancellor's political directives - every minister is responsible for his or her own ministry and policy field independently. These two general principles of German politics also have a substantial influence on the institutional arrangements regarding CCA and DRR as well as their integration. In terms of challenges and gaps, the division of tasks between the Federation and the federal states (and the municipalities) as well as between different governmental departments interferes both with the implementation of DRR and CCA respectively as well as with the harmonisation of both.

The vertical cooperation within DRR is complicated by the distinction between civil protection (with respect to international conflicts ("Zivilschutz")) with administrative responsibility at the federal level and civil protection with respect to all other kinds of hazards and threats ("Katastrophenschutz")) that falls under the responsibility of the federal states (see section Understanding the German Context: Terminology and a brief History of DRR in Germany). As Martin Voss points out, „in other countries with a more centralised system, it is often expected that the BBK could take the lead in transboundary situations that involve several federal states which is not the case" (interview with Voss, January 5th, 2017). Therefore, in view of disasters that cross the borders of federal states or even nations, some actors such as Jens Lattmann of the Association of German Cities (Deutscher Städtetag; DST) call for an institutional restructuring that abolishes the separation of "Zivilschutz" and "Katastrophenschutz" and the affiliated administrative separation (BBK & DST 2010: 4). Also, the distribution of power and legislative frameworks at the different levels is not the same for CCA and DRR, e.g. there is a National Adaptation Strategy for CCA but in terms of a national DRR strategy this only exists for Critical Infrastructure Protection. Reimund Schwarze calls this a "mismatch of responsibilities" as there is a limited charge to the national level in terms of German DRR[77] in comparison with CCA (interview with Schwarze, January 7th, 2017).

Regarding horizontal cooperation, the fact that DRR and CCA are not based within the same ministerial portfolio (CCA is mainly within the responsibility of the Environment Department, while DRR falls under the area of competence of the Department of the Interior) is the case for most sectors mentioned as relevant for CCA in the National Adaptation Strategy:

> "With respect to CCA the administrative structure not only encompasses different administrative levels, but also different government departments at all levels. At federal level the department of environment has the lead, but the list of the different fields of action given in the national strategy of adaptation to climate change at first glance reveals that other ministries are in charge of implementing the strategic goals. Accordingly, constant information exchange and coordination between the different government departments is central" (interview BBK, 13th January 2017).

[77] Some interviewees speculate that this might change when governments rearrange their DRR structures to comply with the Sendai Framework (cf. UNISDR, 2015)

While initiatives focusing on such information exchange and coordination between the different government departments do exist (such as the working group on "Climate Change and Adaptation in Civil Protection" or the agency alliances and cooperation described in section 2.3) interviewees mentioned a rivalry between the ministries and the associated agencies. While interviewees usually referred to this rivalry in a way that each department is eager to keep as many responsibilities as possible, unclear distributions of responsibilities can also lead to the opposite case such as in the case of critical infrastructure providers:

> "Given the inadequate approach of the various relevant federal ministries (for example, the Federal Ministry for Economics and Technology, and the Federal Ministry of the Interior) to incorporating responsibility for climate change adaptation by private-sector critical infrastructure providers into their respective domains, this responsibility should be delegated to an agency" (Schneider 2014).

When looking at the harmonisation of CCA and DRR, most initiatives aiming at cooperation between the DRR and CCA communities mainly involve federal level stakeholders and institutions while the actual implementation of measures falls under the responsibility of the federal states and municipalities. The UBA is aware of the fact that federal cooperation is quite mature but when looking at the departments on the Länder-level, everyday administration of the ministries runs rather parallelly: "There is awareness on both sides that CCA and civil protection have to come together especially in terms of extreme weather events but the structures that are decisive for taking measures are separated" (interview UBA, January 16th, 2017). Moreover, stakeholders active at the Länder-level such as Herbert Trimbach who is leading working group V on Fire Fighting Issues, Rescue Services, Disaster Prevention and Civil Defence within the Permanent Conference of Interior Ministers of the Federal States, stress the point that from a short to mid-term perspective, the harmonisation of DRR and CCA is not likely going be a priority for administrations dealing with civil protection at both federal states and municipal levels since these are rather busy with implementing the concept for civil protection (KZV)[78] which is legally binding while the integration of CCA in many cases is not.

Besides this, some of the interagency mechanisms have been described as "predominantly characterised by the features of negative coordination: The 'lead' ministry assumes a steering role, information is collected rather than shared, consensus is based on the veto-right of single ministries and the coordination output (‚Aktionsplan Anpassung', APA) does neither reflect a shared concept of adaptation policy nor joined policy measures. The coordination process as well as the APA reflect the selective perceptions and single organisational interests, which become manifest in defending individual areas of competence, the veto-rights based on the departmental principle as well as in the dominance of single departmental projects in the APA" (Hustedt, 2014).

The German Strategy for Adaptation to Climate Change also focuses on the federal level, however, explicitly targeting other administrative levels as well (Bundesregierung 2008: 4). This is essential in order to be relevant for civil protection with its competencies distributed at different levels. Especially DRR related to extreme weather events, which dominates the discussion on the relevance of CCA for civil protection, traditionally falls into the responsibility of the federal states and municipalities (BBK 2016: 9). Wolfram Geier, Director of the Department of Risk Management and International Affairs at the Federal Office of Civil Protection and Disaster Assistance (BBK) underlines the differences of CCA measures between federal and Länder level:

> *"The range of possible measures taken at the federal level to a certain degree reflects the (limited) responsibilities of the respective administrative structures in the risk management of natural hazards: the federal institutions mainly engage in overarching, basal questions such as providing information and advice, coordinating working groups, advancement of the information basis for all other actors by way of research or the identification of general recommendations for adaptation options at other levels. The National Adaptation Strategy has counterparts at the Länder level. The actions to be taken*

[78] https://www.bmi.bund.de/SharedDocs/Downloads/DE/Broschueren/2016/konzeption-zivile-verteidigung.pdf?__blob=publicationFile

in order to implement the strategy in the area of civil protection (here, accordingly, in the sense of Katastrophenschutz) necessarily differ at Länder level in that they are clearly more to the operative side."

Therefore, the federal states` climate adaptation strategies are of special importance. When looking at these strategies, the topic of civil protection is dealt with in very diverse ways (see also section 2.2.1.8): while some explicitly mention the topic and elaborate on relevant actors, potential or existing adaptation measures, formulate objectives and responsibilities while others rather do not mention civil protection as a separate point (BBK, 2016, p. 25). Even though this diversity of approaches makes an integrated approach more complex, it reflects the overall stakeholder complexity within the German DRR system. As Wolfram Geier (BBK) remarks:

"Even if the responsibility for civil protection is clearly situated at the ministries of the interior both at federal and Länder level, there is a strong need for constant discussion and reconciliation with the administrations under the responsibilities of other government departments as, for instance, questions concerning flood protection or risk management in the context of hazardous facilities, are shared with the departments of environment and/or economy at all administrative levels. This situation clearly is not one specifically influencing the cooperation between DRR and CCA but a general condition of the administrative system of Germany as a federal state - yet, it is a condition that constantly needs to be kept in mind when seeking for cooperation with DRR: the abbreviation "DRR" in Germany does not relate to a monolithic entity or at least a homogenous structure, but to a variety of actors with highly differentiated responsibilities."

On the other hand, stakeholder complexity has – according to interviewees – the great advantage that the German system allows for very local solutions. While Germany's decentralised structures retain strong benefits (fast response, deep local knowledge, popular support), the question remains whether the system will function adequately when exposed to increasingly demanding scenarios, such as large-scale power and infrastructure failures (Reichenbach et al., 2008). Most interviewees mention the political and administrative complexity to be one of the most important challenges related to the harmonisation of CCA and DRR. Nevertheless, interviewees (as well as policy-makers and security professionals interviewed in other studies) continue to regard Germany's historically grown and decentralised structures for civil security as exemplary with comparatively high levels of public trust and legitimacy (cf. German Red Cross, 2010; Hegemann & Bosong, 2013). The strong involvement of volunteers in Germany's civil protection system contributes to maintaining the link to the general public. However, wider social and economic changes including demographic changes and the suspension of military subscription in 2010 (which before regularly provided a great number of conscientious objectors that would serve in relief organizations instead) negatively influence the number volunteers that are at the disposal of Germany`s civil protection system. Therefore, institutions such as the THW seek new ways of voluntary involvement that do not require long-term commitment but are less formalized and more task and event-related. Forms of engagement that rely on social media can also support relief organizations such as Virtual Operation Support Teams (VOST) that are currently being tested in the German context[79].

Funding Arrangements

Earlier assessments of the linkages between CCA and DRR identified structural difficulties in funding arrangements, since the objectives usually reflect the issuing institution`s scope of interest (Birkmann & Teichmann 2010). Likewise, most interviewees stated that a growing popular interest (and accordingly political relevance) in climate change issues within the last years has resulted in a shift of funding in favour of climate change issues. This complies with an analysis of search-term popularity in Germany. Using Google Trends, we compared "Emergency Management" and "Climate Change" as aggregators of both DRR and CCA.

[79] http://vostde.de/

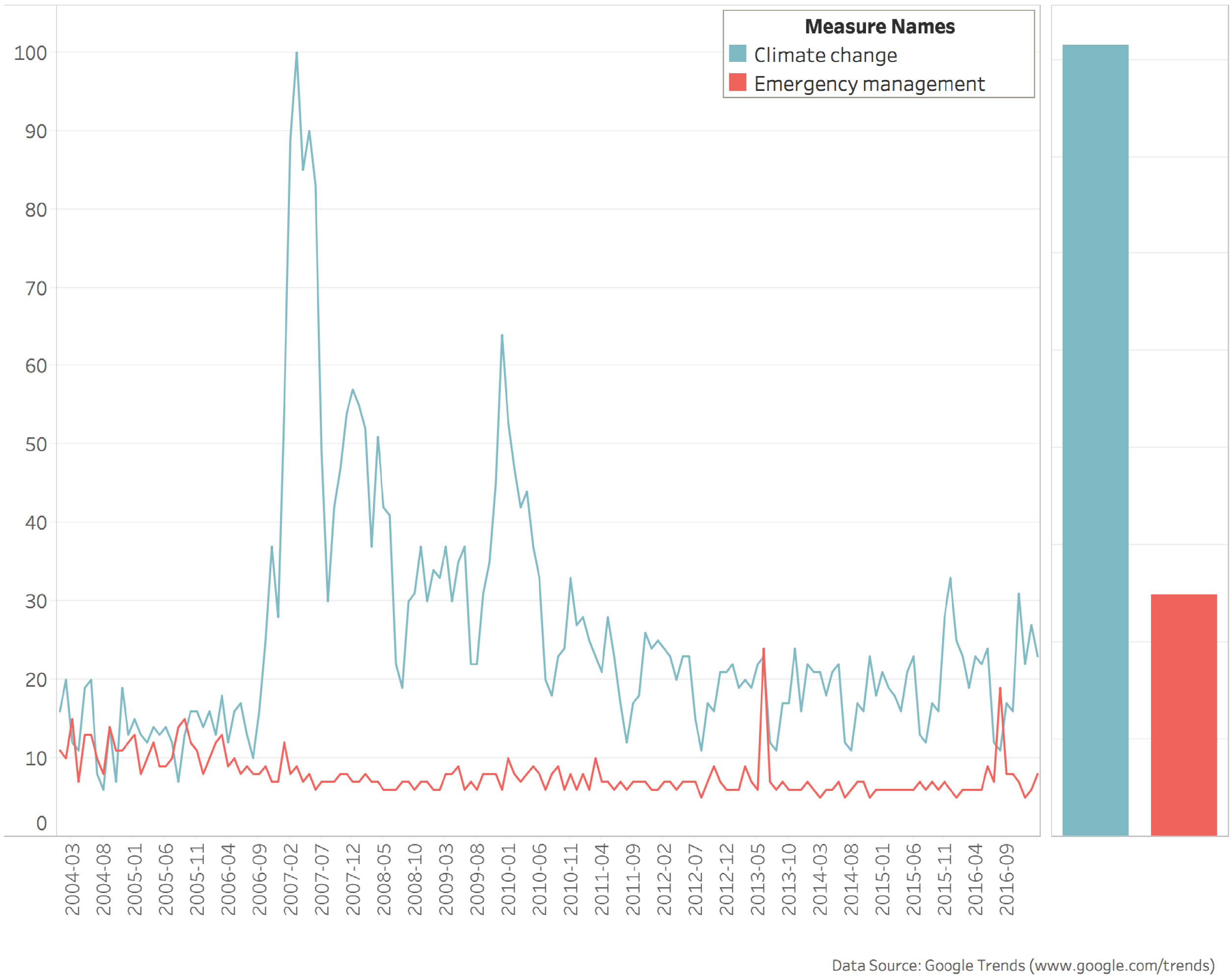

Figure 23: Population Interests through the years for DRR and CCA, based on online searches

The results can be seen in Figure 6 indicates that "Climate Change" has been a topic with increasing presence, particularly after 2006, coinciding with the publication of the Stern Report and the release of Al Gore's movie on the impact of Climate Change, "An inconvenient truth". Averaging from 2004, the topic "Climate Change" is almost three times more relevant than "Emergency Management", with an interesting seasonal fluctuation that may be due to the annual UNFCCC conferences (COP). The peaks in emergency management in 2013 and 2016 could be related to the flood disasters in Germany that occurred in the respective years (described in section Floods).

In general, interviewees perceive an overall trade-off between CCA and DRR regarding funding structures. As Martin Voss, sociologist and Head of the Disaster Research Unit at the Freie Universität Berlin, puts it:

> "One can say that it is precisely because of CCA that there is little willingness to run DRR. Everything is framed in terms of climate change. This is, of course, also visible in the funding structures. All of the classical topics that one could apply for 20 or 30 years ago are only funded today if one also includes the words 'climate change' 20 times" (interview with Voss, January 5th, 2017).

This is however not necessarily a disadvantage per se. Most interviewees understood the increased availability of funds related to climate change research as a possibility of cherry-picking: projects can simply be reformulated according to the funding requirements so that e.g. a climate change element would be included into a DRR project in order to become eligible for funding under a certain scheme.

International studies stress the temporal mismatch of funding schemes in DRR and CCA to be "a major drawback for further integrating the fields of disaster risk reduction and climate change adaptation. Especially problematic were the differences between a rather short-term funding for disaster response by humanitarian donors and the necessity of long-term financial support for adaptation strategies" (Birkmann et al., 2009, p. 7). While this is not perceived as very relevant to the German context, as funding for DRR in Germany does not typically come from "humanitarian donors", but from within the federation, especially experts from the scientific arena suggest a lack of vertical and / or horizontal cooperation in the allocation of funding between the different departments.

As Geier explains, "the general funding of the institutions/organisations involved in the civil protection system in Germany lies with the respective administrations. That is, the federal level has to financially support all institutions within its responsibility, such as the Federal Office of Civil Protection and Disaster Assistance (BBK) as well as the Technical Relief Organisation (THW, the operative organisation held by the federal level). The federal level does also give additional funding to the Länder for sustaining the operative forces the federal level relies on in order to fulfil its tasks in terms of Zivilschutz. The Länder delegate the organisation of the operative forces at the communal level – accordingly the general funding of day-to-day emergency management that involves the local fire brigades and the relief organisations generally is in the hands of the communal level. More closely to the idea of "initiatives" are the funding schemes of the ministry for the environment at federal level (BMUB). It provides project based funding for initiatives at communal level in all fields of action of the German adaptation strategy."

Accompanying the Adaptation Action Plan, since 2011 through the program „Förderung von Maßnahmen zur Anpassung an die Folgen des Klimawandels" the BMUB finances measures to adapt to climate impacts. As the programme intends "multiplier effects", especially measures with a societal model function and high public visibility are targeted. The programme has three key areas: 1) adaptation strategies for businesses, especially within SMEs and municipal companies, 2) development of educational programmes on climate change and adaptation and 3) municipal lighthouse projects and local as well as regional cooperation.

A first evaluation of the funding programme (Huschit el al., 2014) shows that, 35 projects were funded through the programme from 2011 to 2014 with almost EUR 7 million in total of which 5.6 million went into the third pillar "municipal lighthouse projects and local as well as regional cooperation"(ibid: 8). The analysis of project topics also shows that civil protection as a crosscutting issue was not among the fields of action that received funding until 2014 (ibid: 13). However, the number of projects had risen to 70 in April 2016 (BMUB, 2016) now also including a project in the field of DRR. Also, the field of action with most activities by 2014 was "water" including projects on flood protection, coastal protection etc. which are obviously strongly related to DRR. Further, the statistics regarding recipients of funds shows that universities and research institutions are overrepresented in relation to municipalities, NGOs, businesses and others (ibid:17).

This underlines the statements of interviewees that municipal actors often might not have the same experience in applying for funds as university staff and researchers. It also underlines statements and studies such as Birkmann et al (2007, 2009) that the most well-developed issues related to CCA and DRR are water issues.

Another funding scheme of the BMUB that also includes the funding of CCA activities is the National Climate Initiative (Nationale Klimaschutzinitiative). It more generally aims at funding activities at different levels and not only in CCA but to an even higher proportion in mitigation. Since its start in 2008 until the end of 2014 around 19,000 projects were financed with a total budget of more than 555 million Euros (BMUB 2015). The National Climate Initiative's programmes especially promote

- climate mitigation in municipalities, and in social and cultural institutions,
- innovative projects in industry and in the consumer, education and municipal sector,
- highly efficient small combined heat and power systems (mini CHP systems), and
- commercial cooling and air-conditioning plants.

As one can see from the above, there is quite a diversity in funding for both scientific research on and implementation of climate change adaptation, in some cases also explicitly related to disaster risk reduction. However, as several interviewees pointed out, for "every day" operational activities of civil protection institutions, municipalities or businesses, funding is not available to the same extent. The problem is not necessarily that funding is not available per se, but that funding programmes do not reach the relevant target groups on the ground.

There are several reasons for this phenomenon. According to Wolfram Geier, the feedback from individuals, working groups and discussions with stakeholders at the Federal Office of Civil Protection and Disaster Assistance (BBK) suggests that one reason is a deficient awareness of "other" department`s activities, namely the funding available for CCA by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB):

> *"The funding schemes named above are all provided by the environmental department but give funding to initiatives from all kinds of different contexts including civil protection. But: the institutions of the civil protection system might possibly not be looking for funding here and the BMUB as a potential donor might not be known to the respective target group. There might be a lack of awareness that the everyday task of the civil protection organisations, such as, constantly improving the operations in emergencies caused by weather conditions, might also be considered an important CCA activity. The activity then is not "framed" as a CCA activity by those who perform them every day and, accordingly, the idea of seeking for funding schemes under this headline does not come into play"* (Interview with Geier, 13th January 2017).

Another reason is that many funding programmes ask for an own financial contribution from the applicant, often amounting up to 25% of the total costs ("Eigenfinanzierungsanteil"). A lot of cities and communities are not able to provide the necessary amount of financial resources. Accordingly, these programmes might not be appropriate for every community who would like to engage in CCA via applying for funding.

On top of financial resources, many funding programmes also require human resources in order to obtain funding, simply because of the capacities needed to write a proposal or application:

> *"Writing a promising application for funding can be a demanding task which requires well-informed, experienced staff members. For communities which do not have the personnel resources needed the application process might be challenging and, at times, disappointing. This aspect is particularly relevant against the background of the predominantly voluntary organisation of the German civil protection system. There is a need for comprehensive `helpdesk services` in the funding institutions that is approachable for those who are thinking about applying"* (Interview with Geier, 13th January 2017).

In other cases, however, there seems to be a lack of available funding especially when it comes to adaptation on the ground, e.g. when talking about the impacts of climate change on the working conditions of safety and security personnel (both in public and private enterprises) or on those of small and medium-sized enterprises (SMEs). As an example, Marc Knoppe, head of the Masters Programme *Security & Safety Management* and Vice Dean at the Technical University Ingolstadt, describes a vivid situation in which the impacts of climate change are directly to be felt by operational staff:

> *"When the protective clothing and equipment for the THW was designed, a certain maximum temperature was presumed. Today, when THW staff is on duty in summer, working on a highway at 35 °C above zero, those people have a high risk getting a heat stroke because of their thick suits. While the*

textile industry tries to improve the quality of protective clothing for relief units, adapting to the higher temperatures, very little public funding is made available for these research activities."[80]

Likewise, little is known about the impact of climate change on SMEs` company assets when comparing those SMEs that take preventive measures to those that do not, e.g. when looking at delivery failures due to climate induced events such as floodings[81].

Political will/Motivation

Expert interviews reveal rather heterogeneous perspectives regarding political will to integrate or harmonize CCA and DRR. Stakeholders within the relevant ministries` associated agencies perceive political will to be existent within both the CCA and DRR communities, while "outsiders" (i.e. interviewees from academia, private sector and civil society) are more critical in this regard. Most of them agree that a general will can be observed but that there is a trade-off between political will and a) economic interests as well as b) political retention of power:

> *"I would say that a political will exists in this country, but only to the extent that it fits within a certain economic perspective. Political will is there on a fundamental level – I think that is the German dogma – insofar as it is market-compliant so that it can occur in a more export oriented manner, and in that way connect other markets, support its own technologies. That is, it is present wherever its own benefit exceeds the adaptation and adjustment costs. Pure adjustment at one's own expense, that is, without additional benefits for the donor-country Germany became much more difficult over the last decade. This isn´t generally evil to look for win-win-solutions, but it excludes many ethical and humanitarian needs" (interview with Voss, 5th January 2017).*

Oliver Hauner from the German Insurance Association (Gesamtverband der Deutschen Versicherungswirtschaft (GDV) stresses the interest of political actors to be reelected:

> *"Political will to integrate climate change adaptation measures into legislation depends on how well it fits the mainstream. If you have to communicate an inconvenient truth it becomes difficult and when it comes to natural hazards the messages are usually not too positive. It costs money to prepare for them and you talk about risk so you do not become more popular as a politician. When you make a revision of the building act then this is fine but when you want to change something that has a real impact on citizens and municipalities then you encounter greater resistance."*

According to Hauner, this can lead to rather odd situations in particular cases: "Especially, if professionals within ministries, agencies and the like are aware of certain risks and are therefore willing to act preventively, while politicians are unsure about the public opinion or the impact of certain measures on the public finances respectively the overall economic development". Hauner points out that "politically influenced communication therefore tends to trivialize risks or tries to make sure, that the risk is identified and fully under control. But if the risk finally has materialized, every now and then the `blame game` is played by putting the blame on the administration or on others". When looking at studies regarding that topic, during and after the flood in 2002, climate change was made responsible; after the flood of 2013, the general public opposing to certain flood protection measures was blamed (by politicians) in the media (cf. Otto et al., 2016; Becker and Rexhausen (2015)).

Experts in earlier studies have pointed out that a lack of knowledge, awareness and interest for crisis management among the wider population is related to missing day-to-day emergency management and relevant programmes for public education and popular exercises (Hegemann & Bosong 2013).

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[80]As part of their adaptation to climate change, the BBK has conducted a survey on the impacts of heatwaves on operational staff active in DRR. Results show that fire brigades and THW have not experienced relevant heat-related Personalausfälle while other relief organisations did have problems with this issue in the past (BBK, 2016, p. 44)

[81] Exceptions are e.g. Kreibich et al. (2007) and DKKV (2015b)

One example are natural hazards information systems that enable citizens to evaluate the exposure to different hazards at a certain location. Hauner points out that a nationwide information system[82] like in Austria would be necessary so that all citizens could take appropriate precautionary measures on the household level but that these are still politically unpopular as a better knowledge base on location-specific hazards might lead to a loss in value of affected properties, although the introduction of such a system was decided by the UMK after the flood of 2013.

Besides the mentioned barriers, interviewees criticize a general tendency of political will with regard to disaster prevention to be rather event-related, i.e. that political will to act is always present in the aftermath of a hazardous event but gradually decreases the more time elapses after the event. This is illustrated by the fact that most interviewees mentioned heavy rainfalls (such as the ones that occurred in Germany in May / June 2016) as a political motivator for the harmonization of DRR and CCA. In general, most interviewees mentioned the fact that both individual and institutional stakeholders have an interest in keeping as much political power and therefore responsibilities within their portfolios which sometimes hinders effective collaboration and harmonisation of CCA and DRR in terms of political will.

Legislative Integration of Frameworks

As discussed in section 2.2.1.10 there is only a partial integration of climate change impacts or adaptation requirements as targets, principles or even trade-off aspects in relevant legislation. For those regulations that are already climate-mainstreamed i.e. the Federal Regional Planning Act (Raumordnungsgesetz (ROG)), the Federal Building Code (Baugesetzbuch (BauGB)) and the Federal Water Resources Act (Wasserhaushaltsgesetz (WHG)), there is still little practical implementation on the ground. According to Bubeck et al. (2016), one reason is the short time since the new legislations came into effect and the resulting lack of methodological tools and protocols for implementation. He adds that Regional and Urban Development Plans have both long drafting procedures as well as duration of validity so that integration of climate change issues takes time.

Best practices regarding implementation of CCA issues on the municipal level have often evolved within pilot projects that were promoted and financially supported by the government and / or accompanied by scientific research. While there is quite a number of guidelines and tools that aim at distributing examples of best practices, Bubeck et al. (2016) point out that smaller municipalities with less resources to tackle a complex topic such as CCA should increasingly be targeted.

When explicitly looking at an integration of CCA and DRR in legislation there is rather little progress besides the Technical Rules on Installation Safety (Technische Regeln für Anlagensicherheit (TRAS)) that take into account the effects of Climate Change as discussed in chapter Legislative Integration of Climate Change Adaptation. The same holds for the Floods Directive and its implementation in the Federal Water Act. Still, with regard to flood management, the 2013 event and the current legislation, “there is a chance that a more integrated flood risk management will become permanently implemented” (Thieken et al., 2016).

Little progress in terms of legislation is perceived as a gap by interviewees and reflects earlier surveys on the topic of CCA and DRR in Europe such as the one by the European Forum for Disaster Risk Reduction (EFDRR, 2013) in which legislative integration has been pointed out as a major challenge.

While the harmonization of policies on the federal level - despite the stakeholder complexity of the German system - is quite mature on the federal level, provisions for individual precautions are rather weak. As Oliver Hauner from the German Insurers points out, there is a need for mandatory provisions rather than for optional or advisory regulations. Reinhard Vogt, former head of the flood protection agency of the City of Cologne, adds that there is a clear lack of legal provisions for climate-relevant local protection of property. The lack of subsidies for property-level protection measures regarding floods was also highlighted by DKKV (2015).

[82] such as the *„Zonierungssystem für Überschwemmungsrisiko und Einschätzung von Umweltrisiken“* (ZÜRS Geo)

Procedural and Legal Frameworks in Transboundary Disaster Management

Regarding transboundary disaster management interviewed experts and existing literature, both suggest that flood management on transboundary rivers is a best practice example. Procedural and legal frameworks have substantially improved within the last 15 years in particular in terms of flood warning, where clear regulations and agreements are in place in most of the regions. “Large scale, transboundary hydro-meteorological events like the Elbe/Labe floods in 2002 and 2013. Comparison of DRR and CCA capabilities in 2013 vs. 2002 demonstrates substantial progress that has been made on transboundary and transnational exchange of critical information and resources to deal with such disastrous situations” (interview with DWD).

Explicitly mentioned as decisive for improved transboundary management of natural hazards by all interviewees were the Floods Directive and the Water Framework Directive. As a legal act, mandatory for EU members, the directive has been a crucial step been towards cooperation and joint objective-setting across national borders. This is why most initiatives mentioned as best practices in transboundary management were related to riverine and coastal risks, such as the International Commissions for riverine protection (International Commission for the Protection of the Rhine (ICPR), International Commission for the Protection of the Elbe River (ICPER), International Commission for the Protection of the Danube River (ICPDR)) or the Coastal & Marine Union (EUCC) and the Wadden Sea Forum.

One of the main points of critique regarding the German system for transboundary disaster management in the past was the lack of a national contact point (German Red Cross, 2010). This situation has been changed however: since June 2010 the GMLZ at the BBK has taken over the task of Germany`s National Contact Point and therefore functions as the official centre for alerting and informing the relevant actors in case of disastrous events.

The BBK is also active in other dialogue activities with Germany’s neighboring states on issues concerning the efficiency and effectiveness of civil protection and emergency management to create synergies in cross-border cooperation such as the international high level expert meeting on the role of civil protection and emergency management in a changing security context in 2017.

However, in terms of legislation, German law does not address the issue of international disaster assistance besides existing bilateral agreements. This does specifically apply to the case in which Germany itself would be in need for assistance from other countries:

> “This lack of relevant legislation can primarily be explained by the fact that so far there has not been a disaster on German territory resulting in a (true) need for international assistance. The general assumption among German authorities and organisations is that in hardly any case imaginable would Germany actually need to request international disaster assistance. Therefore, national stakeholders do not see any requirement to fill this legislative gap. While the system has indeed proven successful until now, the question remains open as to whether the complex and decentralised German system will be able to indeed coordinate and operate effectively, particularly in the occurrence of a disaster of a scale that would make Germany dependent on international assistance” (German Red Cross 2010).

Mismatches

Interviews point to the fact that there are very diverse perspectives on the meaning and relevance of the so-called mismatches among stakeholders, i.e. practical barriers in implementing an effective link of DRR and CCA that were described by Birkmann (2009, 2010). According to his classification, mismatches can be categorised into three key areas: scales, knowledge and norms.

While aspects of knowledge and norms are partly covered in other sections of the report, within the applied conceptual framework, special focus was on scale issues. Scale mismatches cover three types of scales: spatial, temporal and functional. All of these are relevant for developing DRR and CCA strategies. The spatial mismatch refers to the fact that climate change issues have mostly been studied on a global scale while disasters are mainly analysed with a regional or local perspective. Spatial mismatches were mentioned by experts mainly in terms of incoherent databases that do not link CCA and DRR data in assessments of risks and vulnerabilities. Most experts underlined the relevance of temporal mismatches since long-term, slow onset climate risks are rarely considered in DRR practices. Also referring to the temporal scale, Voss emphasized that all solutions that seem functional within a certain context at a specific point in time are not evaluated according to their long term effects at all (interview with Voss, January 5th, 2017). Functional scale mismatches refer to the governance of DRR and CAA and have been described separately at length in section Institutional Barriers and Stakeholder Complexity since both interviewees and literature analysis suggested institutional barriers and stakeholder complexity to be a major gap in the German context.

Challenges and Gaps in Risk Perception and Assessments

Risk Perception

While the synergies and the need of bringing CCA and DRR together are discussed at length in many scientific articles, professional reports and policy papers, the relation of DRR and CCA and how this relation should be translated into collaborative structures remains unclear. As Birkmann et al (2010) point out, it has been argued by some that CCA should be mainstreamed into DRR while others claim that DRR can be coined as a crosscutting topic within CCA: “These conceptual differences are indeed one of the factors that have so far prevented an effective linkage between both communities”.

The German Adaptation Strategy to Climate Change belongs to the latter, defining DRR as a crosscutting issue within a general CCA strategy. Whether or not this makes more sense from a technical point of view than the other way around (in terms of enhancing synergies, effectiveness and efficiency of measures related to CCA and DRR), many interviewees voiced doubts about this conceptual approach. Some argued that climate change is only one driver of disasters among others and that many risks are not influenced by climate change at all, others pointed out that the issue is not about integrating one into the other but rather about harmonising the two in terms of cooperation.

It can be observed however that such epistemological gaps regarding the understanding of risk and the relation between DRR and CCA do not run between DRR and CCA communities but rather between different disciplines. Also, both the existence of any epistemological gap as well as the existence of CCA and DRR communities per se is rather stressed by researchers, much less by practitioners. Wolfram Geier from the BBK for example remarks that “the “labelling” of an activity or an institution as either one or the other seems counterproductive and, possibly, missing the point. Of course, one can think of purely organisational or academic questions related to CCA. But mostly “doing” CAA in terms or application would not work without doing it in specific fields of activity.”

Disciplinary borders matter especially when looking at the differences between social and natural sciences. The field of climate change research is dominated by the IPCC-process and by the natural sciences per se with the resulting influence on risk perception. This is criticized by social scientists working on these issues, especially with regard to the dominance of quantitative data in risk assessments. Martin Voss, sociologist and Head of the Disaster Research Unit at the Freie Universität Berlin points out that “scientific approaches influence the risk, the assessment of risk, because they place more value on what can be quantified. It is always easier to push quantified aspects through. They are easier to fund, they can be displayed, they are easier to report, etc. While this can be quite productive, risks are social phenomena and can mostly not be evaluated through a technical formula” (interview with Voss, January 5th, 2017).

Besides this perspective of socially constructed risk there are already some divergent perspectives on risks even within those communities that work with technical and quantitative assessments of risk.

Risk Assessment

The assessments of risk and vulnerability in Germany described in chapter 3 differ in terms of methods and approaches: in DRR, risk is generally calculated according to the risk formula of the International Organization for Standardization (ISO 31000 and ISO 31010[83]), e.g. within the National Risk Analyses in Civil Protection (cf. section National Risk Analysis). Within this methodology, risk is understood as the product of the potential occurrence of an extreme event ("hazard"), the propensity or predisposition to be adversely affected ("vulnerability") and the presence of people, livelihoods, environmental services and resources or economic, social, or cultural assets in places that could be adversely affected ("exposure"). In general, one can say that risk assessments in Germany generally focuses on one hazard at a time and their strategies are developed on country, state and municipal levels (e.g., Kreibich et al., 2014). This means that multi-hazard and risk assessment are usually not considered. This concept refers to not only considering at the same time more than one hazard type, but also how they may interact with each other, for example one hazard may trigger another (e.g., earthquakes triggering landslides) or may amplify another (e.g., heavy rains or floods may enhance the likelihood of earthquake induced landslides). One of the few studies dealing with this in the German context was to examine the multi-hazard environment of Cologne (Grünthal et al., 2006) which is threatened by wind storms, earthquakes and flooding, although again interactions between hazards are not dealt with.

In CCA, vulnerability is usually more broadly defined as the relationship of all these components, i.e. hazard, susceptibility, and exposure in relation to the capacity of human and natural systems to cope with a certain risk ("coping capacity"). In the Assessment Reports of the IPCC vulnerability is defined as "the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which the system is exposed, its sensitivity, and its adaptive capacity"[84]. This corresponds by and large to the German Vulnerability Assessment`s findings: The full version of the report (only available in German) includes an analysis of 155 studies on vulnerability assessments in Germany. The results underline the conceptual differences between the "risk" and the "vulnerability" approach: Around 40 % of the studies were based on the IPCC`s vulnerability concept, while around 24% relied on the risk concept. The remaining studies either used a combination of both or completely different concepts (UBA, 2015b, p.136).

Regarding the conceptual differences between the National Risk Analysis in Civil Protection and the Vulnerability Assessment in Germany, involved experts pointed out that these were openly communicated and that the "translation" of methodological or conceptual terminology was largely unproblematic. According to interviewees, the remaining terminological ambiguities were not caused by the two (scientific) communities (CCA and DRR) using different terms or using the same terms differently but rather by the scientific challenges involved. In addition, interviewees pointed out that the differentiation between vulnerability and risk as such does not reflect the more recent IPCC approach (as in the AR5 terminology) and resulting scientific literature.

Challenges and Gaps related to Scientific Frameworks

The results of the analyses conducted in this report brought light to several challenges and gaps that are currently present in the relation between the scientific community and Disaster Risk Reduction and Climate Change Adaptation research topics. This section addresses, first, the insights directly obtained from the analyses of DRR and CCA research, and concludes with the challenges observed while conducting the analyses.

[83] https://www.iso.org/iso-31000-risk-management.html

[84] https://www.ipcc.ch/publications_and_data/ar4/wg2/en/spmsspm-e.html

Analysis of DRR and CCA Research Topics in Germany

As described in section 2, text mining analysis was employed in order to get an impression of the content of scientific publications related to CCA and DRR in Germany and the most popular issues discussed within these publications. The keyword analysis assumes that there is a correlation between the frequency in which words are mentioned and their relevance for the studied area. The results of this analysis are depicted in the central cloud in f**Errore. L'origine riferimento non è stata trovata.** for DRR and **Errore. L'origine riferimento non è stata trovata.** for CCA. The size of keywords in the figure corresponds to the frequency in which they were mentioned in the analysed texts.

Keyword Analysis

In the case of Disaster Risk Reduction, some of the most popular keywords are "*FLOOD"*, "*TSUNAMI"*, "*WARNING"*, and "*MEASURES"* (among others of similar relevance). From this it can be assumed that natural disasters associated to floods are of high interest to the scientific community in Germany. The first keyword ("Flood") is coherent with the natural risk associated to the region. Also, "*WARNING*" and "*MEASURES*" are to be expected words regarding the topic, and relate to early warning procedures and security and mitigation measures aiming to reduce the impact of catastrophic events. "*TSUNAMI*" on the other hand, is a more surprising keyword that does not match the expected regional interests. The reason for this result is a rather prolific research project in cooperation with Indonesia (GITEWS: German Indonesian Tsunami Early Warning System)[85] that dominates the analysed text corpus. Since flood-related events are by far the most common in Germany, other regionally relevant hazards such as heat waves fall behind the scientific interest in major international disasters.

The analysis for Climate Change Adaption holds less surprises than the one for DRR, with a predominant presence of "*WATER*" and "*LAND*" as main keywords extracted from the corpus. These two keywords show up consistently in most publications. "*ADAPTATION*" also features as one of the most frequent terms, ranking higher than "*IMPACT*" or "*PROTECTION*" corresponding to interviews and government reports stating that - with the increasing realization that climate change impacts are unavoidable - adaptation has gained more attention throughout the years.

Topic Modelling Analysis

Topic Modelling is a relatively recent approach to text mining, in which clusters of keywords are identified (as shown on the external grouped keywords in figures 7 and 8), aiming for keyword's associations that best describe the most relevant topics in the area. This analysis provided, compared to the previous keyword analysis, more detailed insights into the scientific community interests in Germany.

[85] http://www.gitews.org/1/homepage/

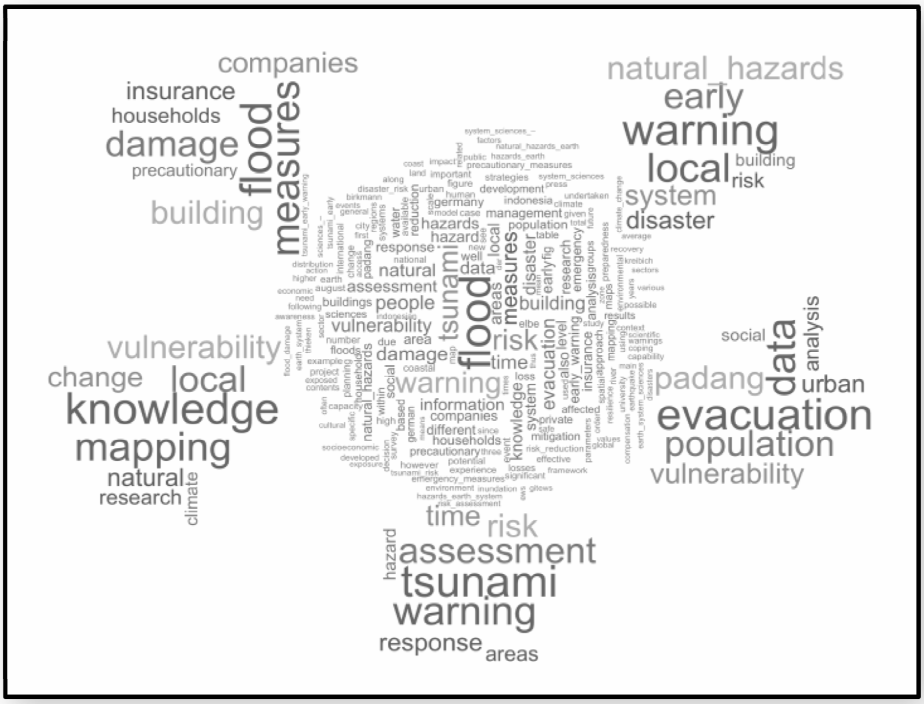

Figure 24: Results of Keyword Analysis and Topic Modelling for Disaster Risk Reduction Papers

The most popular topics in published research for DRR in Germany are:

1. *Early warning systems for natural hazards* (top-right of figure 7). This research topic is basically self-explanatory. One important note comes from the keyword local, in this context, this word indicates a small area of influence for the analysis. This remains coherent with the fact that different regions are exposed to different catastrophes and require specific approaches to face these challenges.
2. *Population protection and vulnerability detection* (bottom-right of figure 7). In this particular topic, there is a clear case study with the Indonesian capital of West Sumatra, Padang. Interestingly, this topic complements the previous one, suggesting that evacuation of urban areas is a highly-researched strategy in the region.
3. *Tsunami risk assessment*, influence areas and response measures (bottom-centre of figure 7): Another topic for which Germany is not the case study. One relevant insight to extract from this, is how important international cooperation is to German research.
4. *Vulnerability detection and knowledge mapping* (bottom-left of figure 7): This topic aggregates two common methodologies in DRR. Similarly to the first topic, the relevant presence of the word local suggest a small area of influence for the analysis, due to high regional specificity.
5. *Flood related damage*, with special focus on economic losses (top-left of figure 7): This is a topic perfectly characterizing research with Germany as case study. The presence of insurance companies in the keyword cloud relates to a clear stakeholder interested in this research.

Analogously to the results of the keyword analysis, the influence of the GITEWS project is made clear, with strong presence in the topic list, particularly with technical approaches for mitigation and early warning measures. For a Germany-specific context, flood related research is also on the spotlight, but research seems to lean more towards damage analysis and social aspects. Since the sample of papers used for this analysis is rather low, and given the facts that research on catastrophes such as wind storms and earthquakes are missing, the conclusions on this analysis need to be taken with care.

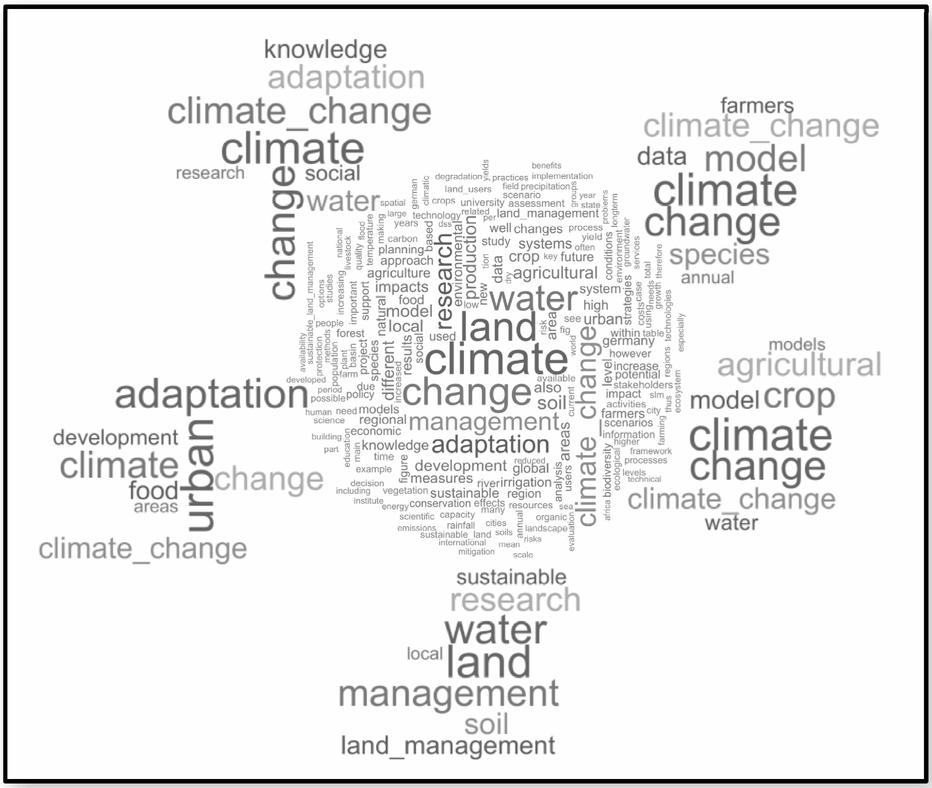

Figure 25: Results of Keyword Analysis and Topic Modelling for Climate Change Adaptation Papers

Regarding the analysis for Climate Change Adaptation research, the following five topics got the most attention:

1. *Climate Change models and data-driven modelling*. (top-right of figure 8): This cluster represents CCA analysis in two levels of aggregations:
    a. On the highest level, it brings forth the importance of modelling and data-driven approaches in Climate Change research (quantitative methodologies where acquired numerical data is heavily used for modelling the analysed systems). Phenomena studied in this area usually present a high interplay between variables, and extend over significant periods of time.
    b. On a low level, it also mentions species and farmers, possibly referring to the impact of climate change in agricultural biodiversity (refer to topic 2 for more details). This is still subject to the development of models to assess such impacts.
2. *Agricultural development and climate change impact on crops* (bottom-right of figure 8): This topic overlaps with the previous one, and suggest that the number of topics selected was too high (There may be four main topics instead of five. This technique doesn't allow for this number to be automatically determined, and need to be manually found). Despite this drawback, some insight still can be found, given the presence of the word Water, suggesting a potential conditioning variable for the analysis.
3. *Sustainable Resource Management* (bottom-centre of figure 8): Self-explanatory topic, where special attention is drawn to Land and Water Management. Similarly to the previous case, this suggests high-impact variables that need to be studied in the context of CCA research.
4. *Urban and Social Development* (bottom-left of figure 8): In this case, food was a popular related term, frequently associated in the context of food scarcity.
5. *Knowledge acquisition related to Climate Change Adaptation* (top-left of figure 8): This topic describes generically the analysed domain, and sets two specific subjects of study: water and social aspects.

Throughout the five topics, some common inferences were made, such as the importance of water and land management, and the relevance of food and agriculture in some papers. Finally, it can be easily seen how impactful the combination of words "Climate Change" is, perfectly describing the domain, highly used in most research, and dominating four out of five topics in the analysis.

4.2.0.1.1 Conclusions of the analyses

The results of the Keyword Analysis and Topic Modelling provide basic insights on the research landscape for both DRR and CCA, although by no means constitute an exhaustive analysis on the area. The three main issues that this approach could not address, were 1) the lack of access to more comprehensive body of scientific documents, 2) the lack of methodology transparency, where the keyword relations are not evident to the user and 3) the popularity of the term "Climate Change" in the field of CCA, is not mirrored in a specific term on Disaster Risk Reduction. In DRR, the scientific community is more compartmentalized by hazards and disciplines. Hence, in several papers maybe only "flood" is mentioned as keyword, but not "disaster management" or "Emergency management". Consequently, there is a tendency in this analysis to underrepresent the work on Disaster Risk Reduction.

That being said, there are four main challenges that should be made explicit, and complement the previous findings:

1) **Uneven popularity:** Climate Change constitute a more popular topic on research, compared to Disaster Management, with 16 papers for DRR and 38 papers for CCA found under the same criteria. While this finding supports the population trend presented before, it may also be related to the third issue mentioned before, on how DRR research presents a certain compartmentalization regarding the use of keywords.

2) **Data availability:** Scientific research in both DRR and CCA faces a challenge in the form of data availability.

   The results of a 2015 DKKV-JPI Climate workshop[86] on the role of loss data for climate change adaptation and disaster risk reduction in Europe clearly showed a lack of data on disaster losses in relation to climate change impacts. This hinders development and validation of reliable loss models, which are essential for risk analyses and efficient decision making. Disaster loss data are still scarce, incomplete or inaccessible and methods in their infancies compared to other scientific fields related to the climate system. The workshop however presented a vision where high public availability of data on social indicators and economic losses, coupled with the insights gathered from research, may be feasible by the year 2020. In this regard, several steps are outlined in order to accomplish this vision, including legislative, operative and institutional improvements and developments. In addition, the data collection efforts initiated by the implementation of the Sendai Framework for Disaster Risk Reduction could also help to gather more loss/ impact data (DKKV, 2016).
3) **Transnational research interests:** due to the relatively low exposure of Germany to natural hazards, some centralization is seen in DRR research, focusing on floods (national risk) and tsunamis (international cooperation). While this holds true for the analyzed sample, its generalization on national level must include the research on earthquakes (GFZ, Potsdam University, KIT) and windstorms (Freie Universität Berlin, Cologne University, KIT), and concerning foreign regions other risk issues such as volcanism are deemed relevant for international cooperation. The situation is not so similar for CCA; while there is a tendency to water and land management research, this could be seen as a central theme for Climate Change, and not an issue arising from regional characteristics.

4) **Bias towards natural sciences:** The role of social sciences is still underrepresented in CCA as well as DRR, favoring natural sciences as the leading research domain. Furthermore, there is an observable gap on the initiatives concerning social sciences from authorities and main funding institutions.

[86] The workshop was organized by members of DKKV's scientific board from the Freie Universität Berlin (Prof. Dr. Uwe Ulbrich), Helmholtz Centre for Environmental Research (UFZ; Prof. Dr. Reimund Schwarze) and University of Potsdam (Prof. Dr. Annegret Thieken, Dr. Stephanie Natho) and funded by JPI Climate.

Challenges/Gaps related to COMMUNICATION in the existing legal/policy aspects

In terms of communication between professionals, both practitioners and scientists, the perceptions of challenges and gaps differ rather substantially between interviewees. As already outlined in section Risk Perception on risk perception, potential communication barriers are rather stressed by scientists, much less by practitioners.

While researchers mentioned the need for a comparative catalogue on a national level to make terminological differences explicit and potentially streamline concepts, experts of governmental agencies rather underlined the fact that issues of terminology and concepts might be overrated. Wolfram Geier (BBK) puts it in a nutshell: "Everyone who works either in CCA or DRR should have noted, that we all agree to disagree on this point."

A certain pragmatism of this sort could be observed with most interviewees. According to them, communication between different actors within present dialogue platforms on DRR and CCA, such as the various interministerial working groups, works quite well despite these potential language barriers. Most experts pointed out that there are no clearly distinguished CCA and DRR communities but rather a very diverse spectrum of disciplines involved in both fields with accordingly different constructions of the problems. This complexity obviously involves misunderstandings and ambiguities. However, some interviewees also understood this situation as leaving space for collaboration that might not have been there if all concepts were clearly defined with indeterminacy disguising potential conflicts.

Another communication challenge that was mentioned more often is the effective exchange of information on best practices. While there is a substantial number of tools and guidelines (cf. section CCA Platforms and ToolsCCA Platforms and Tools), the process of communicating these in a way so that applicable solutions reach the right target groups is a great challenge. This is especially the case when looking at the municipality level. Most actors stressed the lack of a central platform that integrates best practices on CCA and DRR. However, even a national overview of natural hazards and risks is missing. One exception is the platform "Wasserblick" operated by the BfG[87], where all flood hazard and risk maps that were created during the implementation of the Floods Directive by the federal states are summarized. The federal environment agency UBA is the major player regarding the communication of CCA measures and good practices in Germany. Its Competence Centre on Climate Impacts and Adaptation in Germany (Kompetenzzentrum Klimafolgen und Anpassung (KomPass)) provides a number of tools that were described in more detail in section 2.2.1.6 such as the Climate Navigator ("Klimalotse") or the Deeds Bank ("Tatenbank"). Representatives of the KomPass however remark that a task for the coming years will be to develop methods to measure the effectiveness: "How do ideas spread? Do they reach the relevant stakeholders? Do the good practices trigger action in other actors? (interview UBA, January 16th, 2017)".

[87] http://www.bafg.de/DE/05_Wissen/01_InfoSys/WasserBLicK/WasserBLicK.html

Discussion and Conclusions

The German political system and with it the administrative responsibilities for both DRR and CCA are located at different levels within different departments and with a different allocation of responsibilities among those levels, i.e. both policy field face multi-level governance challenges. Due to these fundamental institutional complexities and because both fields face many different tasks (e.g. slow onset disasters, geo-physical disasters), the results of interviews and literature review suggest that DRR and CCA in Germany cannot (and should not) be integrated as such on the federal level but rather need to cooperate and to be harmonised in overlapping policy areas with defined collaboration responsibilities. While vertical and horizontal cooperation could still be improved, the German Adaptation Strategy to Climate Change, defining DRR as a crosscutting issue within CCA, has initiated a substantial number of such collaborative initiatives.

Major gaps can rather be found when looking at implementation on the grounds. Municipalities often do not have sufficient resources to address CCA issues, even less so the complexities of bringing together CCA and DRR in a coherent manner. Both aspects need to be integrated in land use planning such as regional plans of the federal states and urban development plans. To help local and regional actors with the harmonization of DRR and CCA, the federal government needs to invest in capacity building and awareness raising activities, especially at the local level. To enhance equal information on funding opportunities on CCA and DRR, information should be made available also to actors who might not belong to the respective community per se.

Since there is no one-size-fits-all solution for either CCA or DRR at the local level - not to speak of an integrated approach to both – the process of implementing these issues can be informed through best practices but will need to be individually tailored to the location under study and its specific challenges and problems at hand. The need for supporting local level actors with CCA has been identified by the federal government and is explicitly prioritized in several policy documents on that matter. However, the system of civil protection is mostly perceived as so well equipped and functional that its contribution to CCA (as well as in terms of Germany`s capacity to deal with disasters on its own) is taken as a given. This should be re-evaluated considering that the system is based on a shrinking number of volunteers.

To enable a better understanding of potential synergies and future trends in CCA and DRR, a better link and accessibility of data is needed that allows for a unified assessment of hazards, vulnerabilities and risks and takes into account multiple (climate) hazards that occur simultaneously or cumulatively over time and their potentially interrelated effects and impacts.

Finally, communicating potential synergies to relevant actors is a central task that could be improved, e.g. by better linking DRR and CCA measures within existing climate tools and guidelines.

<u>Recommendations:</u>

Governance

- Further institutionalize integrated structures dealing with DRR and CCA, especially on state and municipal levels

Risk Assessments

- Enhance the understanding of possible linkages and cascading effects of natural hazards and climate-related risks (multi-hazard approaches) in risk assessments for Germany
- Improve databases towards linking CCA and DRR in risk and vulnerability assessments in order to enable a unified assessment approach
- Improve data bases on disaster impacts (e.g. losses) as requested by the Sendai Framework

Transboundary Disaster Management

- Better prepare for the case of international assistance on German territory

Funding

- Make sure that local actors have the same access to funding opportunities, both in terms of access to information and regarding potential to receive funding

Communication

- Establish a central platform that links existing best practices in both DRR and CCA
- Establish a central platform that illustrates hazards and risks in all of Germany

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Annexes

Annex 1: List of interviews

Title	Surname, First Name	Position | Institution
Prof.	Bogardi, Janos	Senior Advisor to the Global Water System Project
Dr.	Bubeck, Philip	University of Potsdam
Dr.	Representative of KomPass	KomPass - Climate Impacts and Adaptation in Germany at the Umweltbundesamt (UBA) / German Federal Environmental Agency
Prof.	Fiedrich, Frank	Professor, University Wuppertal
Dr.	Geier, Wolfram	Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK) / German Federal Office of Civil Protection and Disaster Assistance
	Hauner, Oliver André	Gesamtverband der Deutschen Versicherungswirtschaft / The German Insurers
Dr.	Klaus Lützenkirchen	Vice President Corporate Environmental Protection, Siemens AG
Prof.	Knoppe, Marc	Professor, Technical University Ingolstadt
Prof.	Schwarze, Reimund	Professor, Helmholtz Zentrum für Umweltforschung (UFZ) / Helmholtz Centre for Environmental Research
Dr.	Trimbach, Herbert	leads working group V on Fire Fighting Issues, Rescue Services, Disaster Prevention and Civil Defense within the Permanent Conference of Interior Ministers of the Federal States
	Vogt, Reinhard	former head of StEB Köln / Flood Protection Agency Cologne
Prof.	Voss, Martin	Professor, Free University Berlin
	Representatives from DWD	Deutscher Wetterdienst (DWD) / German Meteorological Office

Annex 2: List of Climate Change Adaptation and Disaster Risk Reduction research projects considered in the analysis

Project Name	DRR	CCA	Scientific Approach // Methodology // Selected Techniques
BigWa: Civil Protection Within Societal Change	X		Interdisciplinary - (Applied Social Sciences, Rescue Engineering, Communication Sciences and Informatics) / IT Technology Development
CIRmin/ KIRmin: Critical Infrastructure Resilience as a Minimum Supply Concept	X		Scenario and Case Study Analysis, In-Depth Expert Interviews/ Workshops,
AtlasVR: Atlas of Vulnerability and Resilience	X		Interdisciplinary Knowledge Management / Case Studies / Workshops / Scientific and Organizational Thematic Analysis / Expert Questionnaire / Communication
Push4DRS: Push for Disaster Resilient Societies	X		Scientific and Organizational Thematic Analysis Analysis/ GIS And RS Methods / Data Usage for Disaster Risk Governance / Indicators Development
KritisF&E: Critical Infrastructures Research & Development			Review of Previous Research on Critical Infrastructures / Thematic Analysis
Kophis: Care-dependent Persons in Disaster Situations	X		Qualitative Data and Document Analysis / Expert Interviews / Quantitative Surveys
WEXICOM: Weather warnings: from EXtreme event Information to COMunication and action	X	X	Interdisciplinary - (Meteorology / Social Sciences / Psychology) // Statistical Modelling / Communicational Techniques / Assessment Indicators Development
FloodEvac: Vulnerability of Transportation Structures, Warning and Evacuation in Case of Major Inland Flooding	X	X	Interdisciplinary // Risk Based Approach / Optimization Methods / Monte Carlo Simulations / Scenario Analysis / Modeling / GIS Modeling / Electronic Development / Software and Data
INVOLVE: INitiate VOLunteerism to counter VulnErability	X		Interdisciplinary // Theoretical Social Model Development / Social Mechanisms Analysis
VERSS: Aspects of a more just distribution of safety and security in cities	X		Statistical Evaluation / Indicators Development / Qualitative Dataset Evaluation
ENSURE: Enablement of Urban Citizen Support for Crisis Response	X		Literature Review / Scenario Analysis / Evaluations / System Analysis
Soft Parts: Social Factors of Airport Security	X		Interviews / Surveys / Creative Problem Solving
ANiK: Alpine Natural Hazards in Climate Change	X	X	Interdisciplinary // Human and Social Sciences / Case Study
Kolibri: Communication of location information on population protection in an international comparison	X		Literature Review // Expert Interview / Content Analysis / Population Survey
REBEKA: Resilience of the forces involved in crisis situations	X		Case Studies / Emergency Processes and Measures Analysis and Improvement / Improvement of Organizational Measures

VVL-OECD: Comparative vulnerability assessment of food supplies in OECD countries in case of major damage events	X		Thematic Analysis / Expert Assessment / Case Studies /Literature Review / Expert Interviews / Questionnaires
WiSima: Cost-effectiveness of safety measures in public passenger transport	X		Literature Review and Case Studies / Thematic Analysis /Exploratory Study / Economic Analysis of Safety Measures
PRI-KATS: Prioritization of rescue measures	X		Interdisciplinary (Social - Emergency - Legal)// Scenario Analysis
ALARM: Adaptive solution platform for active technicalsupport when saving human lives	X		Data Acquisition and Exploration / Indicator Development / Exercises and Games
e-Triage: Electronic registration of disaster victims	X		Electronic System Design / Satellite - Based Communications / Database
EVA: Risks associated with major public events – Planning, assessment, EVAcuation and rescue concepts	X		Risk Assessment Tools / Databases / Simulation
EvaSim: Combined traffic and hydraulics simulation for controlling traffic in evacuation measures	X		Simulation / Optimization / Strategy Development
Hermes: Study for an evacuation assistant for use in emergencies during large-scale public events	X		Simulation / Communication Technology / Field Study / Laboratory Trials
LAGE: Integration of existing information systems for joint crisis management	X		Data Standardization / Communication Technology
REPKA: Regional evacuation: Planning, control and adaptation	X		Mathematical Optimization / Simulation / Technology Development
Security2People: Secure IT-Based Disaster Management System to Protect and Rescue People	X		Simulation / Technology Development
SiKomm: Communication for Security: Preventive, proactive and reactive strategies for communications support in security and rescue operations	X		Interdisciplinary // Social / Psychology / Modeling
SoKNOS: Service-oriented architectures supporting public security networks	X		Data Management / Semantic Technology Development / Interactive Technology Development
ACER: Developing Adaptive Capacity to Extreme events in the Rhine basin		X	Scenario Analysis / Modeling and Simulation
AMICA: Adaption and Mitigation - an Integrated Climate Policy Approach		X	Thematic Analysis / Expert Assessment / Communication
ARISCC: Adaptation of Railway Infrastructure to Climate Change		X	Case Studies // Data Management / Risk and Vulnerability Mapping / Risk Assessment /
AVEMAC: Assessing Agriculture Vulnerabilities for the design of Effective Measures for Adaption to Climate Change		X	Data Management / Modeling and Simulation / Vulnerability Mapping
IOACID: Biological impacts of ocean acidification		X	Modeling and Simulation / Thematic Analysis / Integrated Assessment/ Local Experimentation / Socio-Economic Impact Analysis / Domain Specific Experimentation

CC-LandStraD: Climate Change: Land Use Strategies in Germany		X	Scenario Development and Analysis / Integrated Assessment Modeling / Impact Evaluation
CLIMAWARE: Impacts of climate change on water resources management– regional strategies and European view		X	Scenario Analysis / Modeling and Simulation / Strategy Development /
ECODRIVE: Ecosystem Change in the North Sea: Processes, Drivers and Future scenarios		X	Spatial and Temporal Analyses / Thematic Analysis / Scenario Analysis / Indicator Development
ENHANCE: Enhancing risk management partnerships for catastrophic natural hazards in Europe	X	X	Case Studies / Scenario Analysis / Indicator Development / Risk Assessment / Expert Assessment / Participatory Processes
EU-Circle: A pan-European framework for strengthening critical infrastructure resilience to climate change	X	X	Case Studies / Reliability Analysis / Impact Assessment / Modeling and Simulation
KRIM: Climate Change and Preventive Risk and Coastal Protection Management on the German North Sea Coast	X	X	Vulnerability Assessment / Scenario Analysis / Adaptation Measures, Strategies and Actions //Interdisciplinary
TIDE: Tidal River Development		X	Quantitative Resilience Assessment / Indicators Development / Literature Review / Thematic Analysis / Data Analysis / Expert Assessment / Framework Development
WEAM4i: Water & Energy Advanced Management for Irrigation		X	Domain Specific Technology Development / Data Acquisition and Management

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Annexture 03

ESPREssO
Enhancing Synergies for disaster PRevention in the EurOpean Union

Synthesis report of legal, policy and science approaches within the frame of disaster risk reduction and CCA in France.

Compiled by:
BRGM and AFPCN, France
with information cited from reports and documentation published by Météo France, the French Insurance Federation, French Ministries and ONRN

April, 2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 700342. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein

Table of Contents

1 Introduction

1.1 Geographical context

France is divided into 18 administrative regions, including 13 metropolitan and 5 overseas regions.

The 13 metropolitan regions (including 12 mainland regions and Corsica) are each further subdivided into 2 to 13 departments, while the overseas regions consist of only one department each and hence are also referred to as « overseas departments ».Mainland France covers 550,000 km^2 in addition to 120,000 km^2 of overseas territories.

The following regions have overseas region status: Mayotte and La Réunion (Indian Ocean, Africa), French Guiana (South America), Guadeloupe and Martinique (Caribbean, Central America).

Metropolitan France is bounded by the Atlantic Ocean in the North and West and the Mediterranean Sea, in the South (in total, France counts with almost 3.430 km of maritime frontiers). Major landforms are the Alps (East, South-East) and the Pyrenees (South, South-West). In the North and West, the terrain is mostly flat plains or gently rolling hills while the South is mountainous.

Metropolitan France is characterized by a variety of climates with the oceanic climate involving the greatest surface area in its north and West and the Mediterranean climate in the south. This has consequences on some hazard's characteristics, e.g. floods occur as slow-rise floods in the northern part of the country whereas southern and mountainous regions are affected by flash floods.

1.2 Disaster profile

A survey by the International Disaster Data Base at the Catholic University of Leuven (CRED/EM-DAT) of natural events classified as "very serious" having occurred since 1990 ranks France second among the most exposed European countries, with Germany in first place and Italy third.

Eight major natural hazards are likely to affect the French national territory: storms and cyclones, river floods, earthquakes, volcanic eruptions, landslides, avalanches, forest fires and heat waves. The earthquake and volcanic hazard pose a major threat in the overseas departments, in particular Guadeloupe and Martinique.

France is particularly vulnerable to the perils of storms, flooding caused by watercourses overflowing or by runoff and floods caused by mountain torrents. This is due to the length of its coastline and the number and flow-rates of its rivers and watercourses, and also to the specific phenomenon known as Cevennes storms to which a large part of the Southeast of the country is exposed. Mediterranean flash floods trigger 66% of the damage due to flooding in France. Overall, flood hazard zones extend over approximately 27,000 km^2 and expose about 5.1 million people (16,000 communes) to this hazard.

France has a high exposure to the risk of coastal flooding. 40% of metropolitan France's 7,000 km of coastline is considered to be highly vulnerable because of the topography ("mobile" coastline). This means in effect nearly 2,800 km of coastline with high and ever-increasing levels of economic assets, both on the Mediterranean shores and the coastline from Biarritz to Dunkirk. In the Antilles, the seismic hazard is the most feared risk for the foreseeable number of victims.

More than two thirds of the 36,000 municipalities in France are at risk from at least one natural disaster and almost one inhabitant in four and one job out of three is potentially exposed to flood risks, the main hazard in France for the number of affected people and the economic cost of the disaster.

Since January 1st 2001, 1,391 natural hazard events were registered with an associated death toll of 25,193 people, mostly due to heat waves mortality, and over 27 billion Euros of damage in Metropolitan France and overseas departments.

47% of registered (2001-2015) harmful natural hazards were of meteorological origin (thunderstorms, cyclones, bad weather conditions, thunderstorm tornados, hail, snow), 30.6 % are of climatic origin (forest fires, drought, heatwave, coldwave), 15.5 % of hydrologic origin (inundations) and only 6.8 % of geologic origin (earthquakes, volcanic eruptions or landslides).

In terms of frequency of the different hazards, forest fires represent with 376 registered events (27% of total number of events) the most frequent, followed by inundations (228 events; 16.4%), thunderstorms (202 events, 14.5%) and avalanches (195 events, 14%).

It is important to state that within the past 15 years, half of the French communes (18,569) have declared at least once the natural disaster emergency state. 28.3 % of these communes have been in this situation more than 3 times, e.g. once every five years (Catnat, 2016).

1.3 Disaster management structure

The French public system of major natural and technological risk management covers different levels of decision and intervention.

At the national level, three ministries are mainly involved in disaster management issues:

1. the Ministry in charge of Environment[88] for risk prevention and safety information;
2. the Ministry of Interior, for the planning and implementation of crisis management
3. the Ministry of Economy, for the economic risk transfer system, including the insurance sector.

Besides these three key Ministries, the Ministries of Research, Food, Health, Foreign Affairs and National Education contribute in their areas of expertise to the prevention of disaster risks.

1.3.1 Risk prevention and information

Within the Ministry in charge of Environment, the General Directorate for Risk Prevention (DGPR) prepares and implements actions in the legislative, regulatory, technical and organizational domains to improve on one hand, prevention and risk reduction at source, and on the other hand, information and protection for the citizens. It is a complex program with technical, economic and regulatory stakes that are crucial for the State, the local authorities, the industry and the public. Therefore it has an inter-ministerial mission for co-ordinating actions related to risk prevention ad information. Hence, the Head of DGPR is also the Delegate for Major Risks (DRM), relying on four services:

- the Service of technological risks;
- the Service of the prevention of nuisances and quality environment;
- the Service of natural and water hazards (SRNH), which follows actions studied in ESPRESSO;
- the Office of General Affairs and Information Systems.

The actions of DGPR are relayed towards the territories through Regional subsidiaries of the Ministry, in charge of Environment and land planning (DREAL). These DREAL are managing, amongst others, the operational Flood Prediction Services (SPC) and they co-ordinate what is happening in the “départements” where the DRR policy is finally implemented by Departmental directorates of territories (DDT), under the responsibility of the Prefects.

For assessing implementation of the DRR policy by all stakeholders, the Advisory Council for the prevention of major natural hazards (COPRNM), has been established o 30 August 2003. It gathers elected people from the Parliament and local Communities, representatives of the civil society and qualified experts to enrich the thinking of policy makers. It represents the French National Platform within the UNISDR system.

Such an advisory body also exists in each department, the Department council for major natural hazards (CDRMN). It is led by the Préfet and gathers all local DRR stakeholders.

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[88] Today : Ministry for Environment, Energy and the Seas (MEEM)

1.3.2 Crisis preparation and management

Within the Ministry for the Interior, the directorate in charge of the Civil Protection (DGSCGC[89]) is in charge of the preparation and implementation of emergency measures that are necessary to population safeguard. The law of modernisation of civil security, in 2004, has defined the principles of civil security.

One responsibility of DGSCGC is to co-ordinate preparation of rescue organisation plans (ORSEC) at various scales (national, zonal, departmental). It also manages the Operational centre for inter-ministerial operational crisis management (COGIC). The COGIC ensures round-the-clock monitoring of large-scale rescue operations at national level in France and abroad. It is responsible for informing the Minister of the Interior and the State authorities as regards accidents and catastrophes. It also coordinates actions in case of emergency.

The responsibility of crisis preparation and management is subsidiarised to six Defence Zones (Paris, Marseilles, Rennes, Lyon, Metz, Bordeaux), each under the lead of a Prefect in charge of co-ordinating rescue operations on the given territory. For that, he relies on a Centre for zonal operations (COZ) acting as the COGGIC on its zone of responsibility.

At the local level, the responsibility of public and civil security is shared between the State, represented by the Prefet of the department and the city, represented by the Mayor. Therefore, in case of a crisis, there are two Directors of rescue operations (DOS): the Prefet for the department, and the Mayor for the city. The defence zone level intervenes for co-ordinating and allocating resources for crisis management by the DOS.

Practically, the Préfet has at his disposal an Inter-ministerial service of defence and civil protection (SIDPC), acting as a local DGSCGC, helping inter alia the preparation oft the departmental Orsec PLANS. In case of crisis, he establishes a crisis operation centre (COS), acting as the departmental COZ.

On his side, the Mayor, when his City is subject to a risk, has the responsibility to define and implement a City safeguard plan (PCS) to be activated in case of a crisis.

On a day-to-day basis, the public safety activities involve 238,000 professional and voluntary firemen. Firemen belong to departmentally funded bodies, the Department services for fire and rescue (SDIS). The exceptions are the cities of Paris and Marseille where, for historical reasons, they belong to specific Army corpses.

The armed forces may be put at the disposal of the civil authority in the context of their public service tasks in order to lend their assistance to the population in the event of natural disasters or to deal with the consequences of technological accidents. They can offer the possibility of making use of their logistic resources, particularly in the fields of transport and rapid intervention. In addition, they may take part in the protection of certain installations. In terms of international collaboration, France is an active member of the European Mechanism and has also some bilateral cooperation with countries.

It is considered unlikely that a disaster in France would require extra-European means because France is surrounded by countries that are adequately equipped to deal with disasters likely to befall France. Accordingly, when the French authorities (and more specifically the COGIC) decide to call for international assistance, this will generally involve a request for specific equipment.

For advising the Ministry of the Interior for the definition and implementation of this policy, a National Council of Civil Security (CNSC) has been established, gathering the main crisis management stakeholders. For the same reason, in each department exists a Departmental council for civil security (CDSC), advising the Préfet.

1.3.3 DRR information system

The National Observatory for Natural Hazards (ONRN) project was born from the shared vision of insurers, the Central Reinsurance Company (CCR) and the State after 2010 Xynthia storm.

It is a public-private partnership agreement established in 2012 to provide access to and share key information on territories vulnerability, useful to the activities and decision-making processes of stakeholders involved in risk prevention in the following fields:

[89] General directorate for civil security and crisis management (DGSCGC)

- hazards and associated zoning maps,
- assets at risk, vulnerability and resilience at a local level,
- loss records and lessons learnt,
- stakeholders and their projects,
- public risk prevention programs and procedures.

The ONRN website (www.onrn.fr) provides access to the following three services:

- A directory of stakeholders with specialist knowledge of natural hazards and their management and prevention.
- A list of existing public risk map and tabular databases generated by data producers
- ONRN indicators that provide new knowledge on natural hazards.

To complete and extend the availability of information on DRR, a network associating ONRN to regional risk observatories is now under development. In order to ensure coherence between ONRN portfolio and stakeholders needs, the Observatory has a user committee, which is under responsibility of the French association for DRR (AFPCN).

2 Description of existing legal/policy and science approaches

2.1 Legal/policy and science approaches combining CCA & DRR

In France, DRR law and reguuations are contained in the Environmental Code[90] which encompasses the laws and decrees dealing with the matter. The origins of this corpus can be dated back to the 1858 law[91], adopted after the catastrophic general floods having occurred in 1856. Its general principle was to reduce the territories exposure to flood risk, while maintaining the capacity of the river discharge.

This legal framework, initially centred on inundation has slowly evolved up to the last quarter of the 20th century, involving other natural hazards, with three main objectives:

- prevent damage, reduce its impact in reducing exposure and vulnerability of people and property;
- inform citizens in order for them to play a part in prevention and crisis management;
- manage crises and disasters effectively when they occur.

In order to achieve these objectives, the DRR policy relies on a legal, operational and financial arsenal including:

- Tools to improve knowledge about risk and elements at stake which have been enriched recently by the European flooding directive
- Risks prevention plans (PPR) from the 1982 law, and more recently, action plans for flood prevention (PAPI), City safeguard plans (PCS), etc.
- Specific financing schemes, from the CAT NAT insurance contribution which complements the essential input of local public or private actors, as defined by the 1995 law.

Finally, the implementation principles of the policy are:

- The **geographic scale** for defining the components of risk and issuing prevention plans in territories. This scale depends on the considered risk.
- The **state administration (Government)**, namely the Prefet of the department has the responsibility of **defining the risk** within the legal framework defined by the Ministry in charge. It identifies the town territories at risk and informs the concerned local authorities. Afterwards, it prescribes the preparation of the risk prevention plan (PPR) on the territories at risk and, after consultation with the local stakeholders, it endorses the plan.
- The **local authority**, mainly the Mayor, has to **implement the risk prevention policy** on its territory, as it is responsible for urban planning and for citizen security. This means: introducing PPR prescriptions into the local urban development plan[90], defining the town safeguard plan[91] in case of catastrophic event and, amongst others maintaining dykes and levees when present (protection against flood and sea).

The **citizen** has the right to access information on the risks, and the authorities have the obligation to make this information available, especially where a PPR has been approved.

These principles are usually referred to as “the seven pillars” of the French prevention policy, which are illustrated in the following.

2.1.1 Understanding and assessing risks: the knowledge of phenomena, hazards and risks

Greater knowledge of existing hazards and their origin leads to a better understanding of the consequences of phenomena. To optimize research in this sector, France’s prevention policy encourages multi-disciplinary research and promotes research federating public-private partnerships. In this way, a more appropriate response can be conceived, taking into account the level of vulnerability of the area under consideration:

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90 In French : Plan local d'Urbanisme (PLU)

91 In French : Plan communal de sauvegarde (PCS)

- Understanding past events, using historical research and the drawing up of data bases of events and of sites, such as, for example the data base of subterranean cavities, the list of floods, the atlas of areas liable to flood, the standing enquiry into avalanches, the map of avalanche phenomena or the forest fire data base;
- The various arms of the State, the French meteorological service, large numbers of French and European laboratories undertaking research that tries to understand the way these phenomena operate and to anticipate their behaviour whether it is an earthquake, forest fire, hazard involving water or technological hazard;
- Using technical studies to enable the preparation of maps to show the extent and intensity of these phenomena. Studies that will sometimes enable certain phenomena to be foreseen, hours or even minutes before they occur. It is vital that these areas of research are developed and that all of this knowledge is made available to the greatest number, in particular using the Internet, or in cooperation with other bodies.

Major milestone in the past years:

Following the marine submersion events along the Atlantic coast and recent floods in the Var, a partnership program between the ministry of sustainable development, Météo France and the Hydrographical service of the Navy (SHOM) has been engaged in order to improve the early warning of marine submersion (inclusion in the hydrometeorological vigilance system) and tsunamis (establishment of a warning centre for the Mediterranean, CENALT).

2.1.2 Monitoring, forecast and early warning

Monitoring means people can be alerted to a danger using efficient methods that suit each type of phenomenon. Meteorological monitoring, for example, is one essential part of the measures for forecasting storms, avalanches or forest fires. Geophysical monitoring is also very useful in certain geographical areas. Water monitoring is essential for forecasting flooding. Large-scale earth movements, volcanic phenomena are, also, monitored round the clock.

Monitoring systems and early warning services continue to be developed and reinforced where necessary, in particular in overseas departments. Efforts are also deployed to increase the systems reliability and performance quality.

Major milestone in the past years:

Following the 1999 storms, France has established in 2001 a Meteorological vigilance system, which has been extended to floods in 2007 and to marine submersion in 2011, after the storm Xynthia. This system, developed in close cooperation with the Ministry of the Interior, is operated jointly by Météo France (meteorological part – www.meteofrance.com) and by the Ministry of Environment (hydrological part – www.vigicrues.gouv.fr)

Today, the vigilance system covers events like storms, hail, heavy rain and snow, avalanches, river floods, marine submersions and heat waves. The information is given simultaneously to the citizen and the crisis managers for proper reaction and safeguard operations. The meteorological part contributes to the European vigilance system Meteoalarm (www.meteoalarm.eu).

2.1.3 Promote education and risk awareness, safety information and public education

The environmental code describes **the right for the citizen to get information on major risk to which he is exposed** and **the duty for authorities to inform him**[92]. As the citizen needs to be the main actor in his own safety and that of his family he can access information of different kinds, by various means. For example:

[92] Articles L125-2 and followings of the environmental code

- The Departmental document on major risks (DDRM): Established under the authority of the Prefect, this document describes all the major natural or industrial risks present in the department and gives the list of cities and territories vulnerable to these risks. The DDRM is accessible through Internet and distributed to the Mayors.
- The Mayor shall then give detailed information to his citizens through a City information document on major risk (DICRIM) presenting, amongst others, what prevention measures can be implemented and some measures to be taken by the Mayor for safeguarding the City. This document is accompanied by communication and poster campaign.
- Since 2006, the law requires information for a purchaser or tenant of any property, whether built or not, situated in an unsafe area and/or within the perimeter of a plan for the prevention of natural or technological hazards, to be made available (IAL).

Information on major risks and their consequences for people, their property and the environment is available in City Halls and Prefectorates, but it can now be widely accessed on the internet, though the Prefectorates and Cities websites.

The MEEM website operates also a web portal *www.prim.net* giving access to general information on major risks, city by city, in form of files, texts or maps. In includes also the list of declarations of natural disasters, risk prevention plans (PPR) and access to the memory of disasters.

Information for citizens also includes keeping alive memories of past events. Since 2003, to remind people of how high floods can reach, the implementation of standardised markers showing the height of floods and the maintenance of those already in place has been mandatory for all authorities where floods have occurred.

2.1.4 Take into account risks into sustainable planning development

In order to reduce damage from natural disasters there is a need to control the spatial planning of habitat, industry and rural spaces to secure sustainable development of vulnerable territories. The plans for the prevention of foreseeable natural hazards (PPRn) aim to avoid an increase of challenges faced in areas at risk and to reduce vulnerability in those areas that are already urban environments.

The risk prevention plans (PPR) are still the core of the risk prevention policy. Established at the city territory scale, they are urban and land-planning documents crossing hazard maps with assets maps to define zones where constraints are prescribed (stop building, building with conditions, no constraints). They address the material assets (housing and industry) and do not highlight human safety impact. They do not integrate vulnerability assessment and therefore cannot be considered as risk evaluation tools.

Initially build around the river flooding risk, this policy has progressively aggregated other natural risks (seismicity, landslides, storm surges), following important disasters having occurred, such as the storm Xynthia (2010) for storm surges.

After a preliminary consultation process, the Prefect prescribes the PPR. It is established on the basis of studies funded by the state administration. After consultation with local stakeholders and a public enquiry the PPRn is declared to be of public utility by the Prefect. It is annexed to the Local Development Framework (PLU) that has to adapt to it. From then on, planning decisions have to take into account these documents whose provisions rank above all other considerations. The same measures apply to technological and mining hazards (PPRt).

2.1.5 Reducing vulnerability

The goal of mitigation is to reduce damage by reducing either intensity of certain events - flooding, mudslides, avalanches etc. or vulnerability to the hazard - homes, commercial and industrial buildings, historic monuments, tourist sites, telecommunications networks, water, electricity and communication systems etc. Above all, mitigation requires all persons concerned to be trained - architects, civil engineers, entrepreneurs etc. in the areas of design and planning for climate and geological phenomena as well as the building regulations. Insurance cover for disasters is included in damage to Homes and is guaranteed by the State.

Example box

The European Flood directive appears as an innovative text in the perspective of flood risk prevention. It fully integrates coastal marine submersion. It imposes studying hazard impact on four socio-economic "receptors": human health, environment, cultural heritage and economy. It has the advantage of leading to work on vulnerability and resilience for risk assessment and prevention practices.

To give a perspective to the directive implementation, France has adopted a National Strategy for Flood Risk Management (SNGRI – Stratégie nationale de gestion du risque d'inondations) on 15 July 2014, along the following general principles:

- *Increase security of communities exposed to flood and marine submersion risk;*
- *Stabilize and reduce the cost of damages due to inundations;*
- *Reduce the delay for the return to the normal after a disaster.*

This strategy still includes the solidarity principle. It insists on the necessary subsidiarity and synergy between the levels of authorities for an efficient governance of the policy, which is aimed at a sustainable land planning. It insists also on the development of information knowledge for disaster risk reduction, and promotes an approach enabling the citizen to live in facing inundations.

2.1.6 Prepare and manage crisis

Public bodies have a duty to organise all necessary safety measures. Organising this requires a balanced sharing of competences between the State and local authorities. When a rescue organisation is of a certain size or is of a certain type, in each *département*, defence or maritime area, it becomes a part of the Civil Defence Response (see paragraph 1.1.2).

- **The organisation of a Civil Defence Response (ORSEC)**

  This response, on the orders of the Prefect, determines, given the hazards that exist in the *département*, the general organisation of any rescue and draws up a list of all the public and private bodies able to be deployed. It will include all general measures applicable in all circumstances and others that are roper to specific identifiable hazards. The measures in the ORSEC plans also anticipate those measures that need to be taken and the rescue plans to be implemented to counter threats from particular hazards or that are linked to the existence and operation of specific installations and works. Special Intervention Plans (PPI) particularly for those sites classified as Seveso, hydroelectric dams and nuclear sites might also be drawn up.

- **City safeguarding plan (PCS)**

  Within his area the Mayor is responsible for providing a first response. A Local Disaster Plan (PCS) is mandatory in local authority areas where there is a Plan for the Prevention of Foreseeable Natural Disasters (PPRn) that has been approved, or where it falls within an area where there is a particular intervention plan. If there is a disaster it will list the means available to a local authority for use alongside other bodies intervening, rescue services, charities etc.

- **Particular Safeguarding Plan (PPMS)**

  In educational institutions that might be exposed to one or more major hazard, the head of the establishment is obliged to draw up, in the name of (and in cooperation with) the local mayor and the rescue services a Particular Safeguarding Plan (PPMS). This plan should take into account each of the major hazards to which the establishment might be exposed. Regular simulation exercises should then take place.

2.1.7 **Feedback**

2.1.7.1 ***Insurance***

Despite established prevention and intervention measures, the damage and injury caused by a natural or technological disaster, or even a hailstorm can be very important. It is therefore advisable, and often required, to anticipate the economic risk by using insurance.

In 1982,[93] France has established a **risk transfer system**, based on solidarity between all insured stakeholders. It is called the Natural Catastrophes system (Cat Nat), relying on a tax on insurance contracts (12% for housing, 6% for vehicles). This fund represents the State guarantee and is managed by a public re-insurance fund (CCR).

The right to compensation after a natural disaster is subject to the declaration of a "state of Cat-Nat" by a decree from the Ministry of Economy, defining the nature, date and location of the event and the list of cities where this right is opened.

Public goods are not covered by the Cat-Nat system, as by principle, the State and the local Communities are their own insurers. Specific funds have been established by the State to help local Communities.

2.1.7.2 ***Post-crisis analysis (return of experience)***

After the crisis is the time for analysis. Every natural disaster and each technological accident means looking again at practices and certainties. At national level in France, the Boards of Inspectors of the three ministries in charge are leading on site missions after the disasters and report on their findings to propose recommendations for making the policies more efficient. In some cases, like after the Xynthia storm, parliamentary commissions are established, and also make recommendations.

For example, the storm Xynthia (February 2010) and the Var flash floods (2010), have led to take entirely account of the problematic of the coastal flooding, and a more coherent approach of risk component evaluation. Amongst others:

- An update of the guide for the elaboration of Coastal risk prevention plans (PPRL), accounting the impact of climate change;
- The Rapid submersion plan (PSR), including the development of the existing multi-hazards early warning system (the Vigilance system) to include marine submersion and flash floods;
- The procedure for the Action programmes for floods prevention (PAPI), including marine submersion. These action programmes call for the study of risk at a larger scale than the town territory, namely the river basins, a submersible area or an economic perimeter. For the first time they call for some insight on vulnerability through a request for cost-benefit analysis, that require access to socio economic data.
- The development of local strategies for flood risk managements (SLGRI) on the risk inundation territories identified within the European flood directive.
- A National observatory for natural risks (Observatoire national des risques naturels – ONRN) has been created ion support to the strategy. It is a public private partnership aimed at gathering and providing information on the territories vulnerability and for the evaluation of the risk prevention policy. It shall answer to the requirements of the cost benefit analysis and of the risk mapping deriving from the European directive (www.onrn.fr).

The responsibility of the local authorities with respect to the risk prevention has been specified by the law reorganising the local governance structures (MAPTAM)[94]. It reaffirms the responsibility described above. These local authorities have the responsibility of the implementation of the water management policy, which includes inundation prevention and specifically the maintenance of dykes and levees. The novelty is that these community can unite to implement a policy at a larger scale that the classical town territory.

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[93] Law No. 82-600 of 13 July 1982, as amended, relating to compensation for victims of natural disasters, Article L 125-1 of the Insurance Code

[94] Law Nr 2014-58 dated 27 January 2014 on the modernisation of territorial public action

After four years of implementation, these actions are under reviews, and some conclusions may be derived to be inserted in the National strategy implementation plan, which is also supported by the creation on the national observatory for natural risks (ONRN) – to be developed.

Overall, the floods directive and the 2010 disasters have been an opportunity for France to review her and introduce new approaches at larger scales than the town territory.

2.2 Legal/policy and science approaches specifically related to CCA

France has also policies on Climate change adaptation and on Coastal management, also under the responsibility of the Ministry in charge of Environment (MEEM). Without entering into details, these policies are described in two strategies:

- The National strategy on Climate Change Adaptation (SNACC)[95], dated 2013, completed by a National plan on Climate Change Adaptation (PNACC) for 2011-2015. It is followed by the National Observatory of the Effects of Climate Warming (ONERC)[96]
- The National strategy on Global Integrated Coastline Management (SNGITC)[97], dated 2014, with emphasis on the consequence of climate change on the sea level. An important tool for the follow-um of this strategy is the National Observatory of Sea and Coastline (ONML)[98]

Both strategies and plans include chapters on DRR, noting that this specific item will be developed under the responsibility of the DGPR. The hierarchy of responsibility for implementation of these strategies is the same as described above, coherently with the French governance approach. It is also interesting to note the emphasis put on Observatories for the follow-up of strategies and policies. Therefore, observatories will appear as key stakeholders for the ESPREssO project.

Formally, the system appears as ready to ensure a common approach of these topics on the territories, but it appears that some work has still to be done to make some borders disappear. It is still current that instructions from the three directorates come separately to be implemented in the territories.

[95] SNACC: Stratégie nationale d'adaptation au changement climatique PNACC: Plan national d'adaptation au changement climatique

[96] ONERC : Observatoire national sur les effets du réchauffement climatique

[97] SNGITC : Stratégie nationale de gestion intégrée du trait de côte

[98] ONML : Observatoire national de la mer et du littoral

Example box:

The Loire Grandeur Nature Plan and the strategic approach it takes to flood risk management

The "Loire Grandeur Nature Plan", or the "Loire Plan", in the Loire basin has steered the development of flood risk management for 15 years towards a strategy of living with floods instead of trying to reduce the flood risk to nil by controlling rivers. The plan provides for a framework of specific measures in support of studies that provide better models of major floods and flood risks, reduce people's and businesses' vulnerability to the direct and indirect consequences of flooding, heighten public awareness of flood risk and beef up flood forecasting.

The process of selecting flood prevention projects is the subject of discussion in the broader context of water use, environmental protection, and preservation of cultural and recreational activities. This holistic approach acknowledges the variety of interests and groups that attach different values to river resources. It also provides a structure that allows for informed trade-offs. Project selection is bound, among other things, with the water policy guidelines on recognition of the contribution made by floods to recharging wetlands and the water table.

The policy is part of the Water Development and Management Master Plan (Schéma Directeur d'Aménagement et de Gestion des Eaux, SDAGE) formulated by the Moire-Brittany Basin Committee which includes local government, economic stakeholders, central government authorities and associations, including nature conservation associations.

Source: OECD (2010), Etude de l'OCDE sur la gestion des risques d'inondation : Bassin de la Loire, France 2010, OECD Publishing, Paris (http://dx.doi.org/10.1787/9789264056817-cn).

3 Research methodology

The data presented in this report is a compilation of information published in national reports. Major information stems from reports and documentation published by the French Ministries, the French Insurance Association, private and public institutions and associations (BRGM, Météo France, ONRN, AFPCN, French Red Cross…).

The results presented in the following section (Analysis and findings, section 4) are the synthesis of data from different sources:

- An extensive literature review.
- Interviews with BRGM agents, including an analysis of public and internal reports of the BRGM archive, representing professional expertise of more than 20 years in working and exchanging with stakeholders at national, regional and local level.
- An ongoing study performed by AFPCN on the topic of "networks resilience facing natural disasters"[99]. The method used, named "cindynics" has been developed "to identify the dangerous situations created within a system with a view to reduce their sources". Initially defined for risk control in industrial processes, the method can be used for natural risks on territories. The key point of the analysis is to account the stakeholders behaviour in the dynamic causality of disasters, what may give useful information for defining prevention models. This behaviour is dictated by finalities, worths, regulations, facts data and models of the category (e.g. telecoms operators) to which the stakeholder belongs.

We have included in the following section "Analysis and Findings" elements of the discussion in order to comment observations when they are mentioned and to avoid repetition.

[99] "Vulnérabilité des réseaux et catastrophes naturelles", AFPCN, 2014

4 Analysis and findings

4.1 Challenges/gaps related to GOVERNANCE in the existing legal/policy and science approaches

4.1.1 Institutional barriers

In France, DRR and CCA are under the responsibility of the same Ministry, the MEEM, but in different directorates: DGPR for DRR and DGEC for CCA. Therefore, actions are parallel and aimed to not diverge, the challenge being to make the actions converge! The same can be noted for the R&D communities involved in DRR and CCA: separate actions are being promoted with very few common topics.

Interviewed scientists do, in general, not believe in diverging approaches on DRR and CCA among governmental and other structures. They rather pointed out that all implied structures have difficulties to integrate DRR and CCA, because:

- methods to integrate DRR and CCA are lacking,
- uncertainties on climate change are large and difficult to understand (e.g. Hinkel et al. 2015)
- the format in which climate information is provided is not well aligned to current DRR decision making (Hinkel et al. 2015; Brasseur and Gallardo 2016);
- for some aspects, impacts of climate change (especially high emission scenarios) are so large that it is perhaps just impossible to integrate it in DRR polices (see e.g., impacts anticipated by Gattuso et al. 2015 for the ocean and key coastal ecosystems and risks).

As an example, the National Strategy for Inundation Prevention (SNGRI) and the National Strategy for Climate Change Adaptation (SNACC) have been elaborated separately. The preparations of COP21 and WCDRR (Sendai) have also been made separately, but we have to note that the DRR community has been more involved in the COP21 process than the ACC community in the WCDRR process.

Both policies are to be implemented in territories through the regional subsidiaries on MEEM, called DREAL. Implementation of the DRR projects is primarily made in Departements through the DDT, in co-operation with the local communities.

Example box:

Le Cozannet et al. (2013) point out, as a result of their study, that "Intergovernmental and European commitments require European countries to introduce climate mitigation and adaptation strategies. In France, "climate and energy plans" are implemented at the regional level, including adaptation measures that should be based on assessments of vulnerability to climate change. These plans should then feed into regulatory regional land use policies. One of the challenges of this process is to generate realistic scenarios in a context of high uncertainty". In practice, when we reconsider how these plans are implemented, we see that the regions see how to proceed for mitigation (= reduction of greenhouse gas emissions"). However, the results are very heterogeneous on the topic of adaptation. There is a need for guidelines here, and the revised national plan for adaptation is trying to address this need."

4.1.2 **Funding Arrangements**

Current funding arrangement for DRR and CCA initiatives aim to provide adequate resources in order to implement policies and natural risk prevention plans at all administrative levels. The funding sources include:

- **For DRR**, the Government funding sources: A national budget of MEEM and a fund based on private insurance premiums (Fonds Barnier, FPRNM). This corresponds to, as illustrated in section 2.1.6.1, the public system (CatNat), which substitutes to the reinsurance industry in other countries. https://www.ccr.fr/-/indemnisation-des-catastrophes-naturelles-en-france. Above that come funds from local government and communities authorities. Research funding on DRR are also available through the National Research Agency (ANR) and the budget of national Agencies involved in environment (BRGM, IRSTEA, Meteo-France,…);
- **For CCA,** essentially government funding through a national budget of MEEM, the ANR and the National Agencies budgets.

The national plan for climate change adaptation in France has been elaborated at cost 0 (zero), by integrating consideration of climate change in DRR and land use planning policies:

In 2010, the Ministry of Sustainable Development called upon the expertise of French climate scientists to produce a reasoned assessment of climatic conditions in France in the 21st century. Dr Jean Jouzel was appointed to lead this assessment, which was carried out by scientists from CNRS/INSU/IPSL and LGGE, from Météo France, BRGM, CEA, CETMEF, and the CNES. The results are compiled in the series “Le climat de la France au XXIe siècle” which provides climatic benchmarks to inform development of measures for adapting to climate change. A first set of results was published in January 2011. They relied on two regional climatic models from several French institutions, running with two different IPCC greenhouse gas emission scenarii. A second set of results was published in January 2012, producing new regional climatic models in a different version and accounting for different IPCC scenarios (Duong et al., 2013).

This tool is crucial for the many stakeholders concerned with the problem of adaptation, namely local communities, the private economic sector, associations and State run services. The production of such reference data was therefore given top priority (Action n°1) in the French National Plan for Adaptation Plan to Climate Change, which came into force on 19 July 2011. The work received financial backing from the Ministry of Sustainable Development, General Directorate for Energy and Climate (DGEC). The National Observatory on the Effects of Global Warming (Observatoire National sur les Effets du Réchauffement Climatique, ONERC) is responsible for organizing and disseminating the scientific information (Duong et al., 2013; Bonduelle et Jouzel, 2014).
However, there are questions regarding the sustainability of this system given the impacts of climate change on shrinking and swelling of clays (http://infoterre.brgm.fr/rapports/RP-56771-FR.pdf) and on coastal risks (http://infoterre.brgm.fr/rapports/RP-57141-FR.pdf; Le Cozannet et al., 2013).

Example box:

Important progress has been made in France within some limits concerning fundamental aspects such as financial resources at regional level and operational capacity building (HFA National Progress Report 2013-2015). Examples to cite are:

- *The “Plan Séisme Antilles” national program to reinforce, retrofit or rebuild public buildings in accordance with modern earthquake resistance guidelines. Almost one billion Euros in total and about 30 to 40 million Euros per year during 25 years are provided to regional institutions to reach this goal.*
- *Concerning flood risk, almost 1,200 km of reinforced dykes are planned in the framework of the marine submersion prevention plan with a contribution from the state of about 500 million Euros until 2016.*

In both cases, the mobilization of regional and local stakeholders has been a major challenge. This is found to be a consequence of the rigorous budget policies and difficulties to mobilise additional financial envelopes enabling the animation and financing of preventative actions and initiatives of interested public bodies.

4.1.3 **Political will/Motivation**

At present, there is a general political will to integrate DRR and CCA, which is illustrated by the existence and the renewal of the National Adaptation Plan.

Also, it is a declared political will to at least make DRR and CCA converge. This is done by asking operators to account for CCA in DRR projects and vice-versa (it is clear for DRR through the PAPI framework for example). But, often consequences of CCA are taken as an external constraint in DRR plans (ex PPRL accounting roughly for sea level rise), rather than through a coherent approach in the plan.

In some cases, existing legal/policy background may hamper the implementation of political will. This is the case in the context of:

- Non-binding regulations (e.g., land use planning regulation, where there is a requirement for best efforts), adaptation of climate change appears difficult to implement due to lack of methodologies and constraints.
- Mandatory regulations (e.g., coastal risk prevention plans), the methodology exists and is applied, and finally results in concrete incorporation of climate change scenarios in land use planning, whereby it is forbidden to build in some low lying area to anticipate future sea-level rise and avoid maladaptation traps. Some regional actors (e.g. networks of municipalities in Aquitaine) say that this is not sufficient and that the coastal risk prevention plans should be strengthened on the topics of risk preparedness.

A law is currently examined by the parliament to modify land use regulations in coastal areas: the idea is to distinguish (1) area which are under the influence of today's shoreline change variability, and could be eroded within years of a few decades; (2) areas where temporary economic activities are possible on the medium term (a few decades), but which could be lost due to shoreline erosion and sea level rise then; (3) areas ruled by the current regulation.

4.1.4 **Stakeholder complexity**

The prevention of major risks is an activity that involves several ministries, local authorities and various agencies, depending on the context. Each impact of climate change for example has different stakeholders involved (fisheries, ski stations, coastal engineers…). We will outline in the following only the main stakeholders registered in the ONRN database.

Today, 136 stakeholders, including 18 observatories, are registered in the ONRN database, which is not exhaustive. The table below proposes a classification of stakeholders.

Table 1: ONRN stakeholder categories

N°	Category	Who ?
1	**Government**	Ministries (MEDDE, Interior, International affairs, economy, etc), the central directorates (DGPR, DGSCGC, etc) and services in territories (DREAL, DDT, etc).
2	**Elected representatives and Local authorities**	Elected representatives associations (AMF, ANEL, ANEM…), local authorities (Cities, departments, regions), their agencies (rescue, urban planning) their groups (EPCI, EPTB, GEPRI…) and federations (FNAU, AFEPTB…)
3	**Observatories**	Environment regional observatories and research observatories (IPGP, EOST, OSUs,…)
4	**Government agencies**	Public agencies (BRGM, IRSTEA, IGN, Météo-France….)
5	**Education and research**	Secondary and university education, research agencies (CNRS, Universities, etc) and groups dedicated to education (IFFORME,….)
6	**Private sector**	Economic sectors (insurance, planners, notaries, network operators, technical design offices…) and their representative groups (FFSA, GEMA, APREF, CSN, SYNTEC,….)
7	**Thematic NGOs**	Groups of public and private entities, or of citizens working fully or partly on risks, for example : - Non professional groups integrating DRR in a social objective aimed at knowledge enforcement, - Groups of public and private entities working fully or partly on risks on a given territory.
8	**Defense NGOs**	Groups of disaster victims, riparians (UNALCI), for environmental protection de défense de l'environnement (FNE), rescue services (CRF), trade unions….

4.1.4.1 *Who are the stakeholders*

- **Government**: As already stated above, CCA, Coastal ant DRR policies are led by the Ministry of Environment, Energy and the Sea (MEEM), coordinating relevant actions of other Ministries, mainly the Interior, the Foreign affairs, Economy, Housing, Research and Education. All these policies are activated in the territories through the Ministry subsidiaries in Regions (DREAL) and Departments (DDTM). They are obviously part of **group a** of the ESPREssO forum**.**
- **Local authorities**: Cities, departments, regions and their various associations define the second key group. Local authorities are implementing all the considered policies on their respective territories, and to this respect, they establish dedicated offices and networks of practitioners. Therefore they are mainly part of **group b.** But, as they also produce regulation and plans for the civil society of their territories, they also contribute to **group a.**
- **Observatories:** To answer some questions on environment and risk policies, local collectivities, often supported by government and research agencies and the private sector have established co-operative structures gathering and making available information on environment and risks. Furthermore, the implementation of the risk prevention policy, mainly from the European flood directive, calls for the establishment of observatories on the concerned territories. Such structures are obviously not only users but also contributors to the ONRN. They are **part of group b** and support **group 1**.
- **Government agencies**: From their missions and activities (data collection, services, R&D), agencies like the Geological survey (BRGM), the Meteorological service (Météo France), environment studies (IRSTEA, INERIS), etc, support Government, Collectivities, and, sometimes Industry, for the development of knowledge and the development of tools for implementing the policies. They are to be assigned to **group b and group c.**
- **Research and education:** Here we find mainly universities and research laboratories, working in natural, economic and social sciences, contributing to the increasing knowledge of risks. We find also education, from primary school to university, and in the communities, to develop risk awareness within the Society. T**hey are to be in group c.**
- **Private sector**: This group covers all private stakeholders and their associations (industry, insurance, services, technical consulting…). Private sector has first to apply DRR regulations for its own safety, but it is also potential partner of the Government and Collectivities for the definition and the implementation of the policies on the territories where they are working. Specific attention is to be given here to the insurance sector, which is also involved in the definition of risk transfer tools. They are all part of **group b.**
- **Thematic NGOs:** some of these groups focus on risks on a given territory (i.e. the Alps or Provence), gathering entities from the six initial clusters listed above. Others are non-professional organisations

including DRR in a social objective aimed at knowledge enforcement, such as AFPCN! Such trans-disciplinary and trans-organisation bodies often have specific views on the problem, which are of great interest for the project. They therefore are part of **group b**, but, as they may be individual citizens, they also contribute to **group d.**

- **Defense NGOs:** these are first representative of the citizens living in the territories at risk and interested in environmental protection or in the defence of victims. Here we can also introduce NGOs active in the rescue operations like the Red Cross. This category may be included in **group d.**

The link between the two groupings can be summarized as follows:

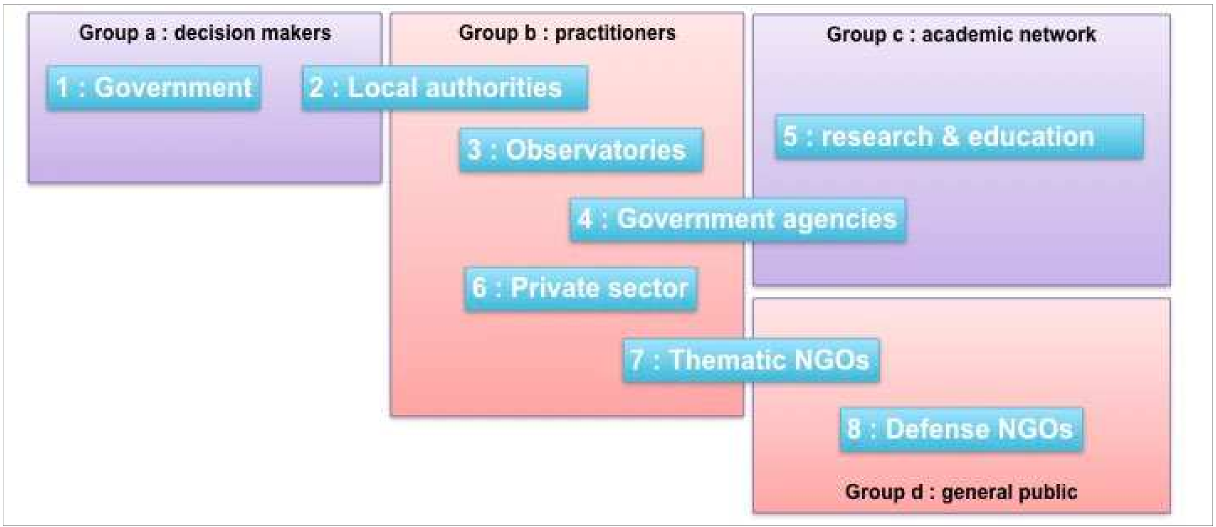

Illustration 1: Links between the two classifications

4.1.4.2 *What are their roles and responsibilities*

The positioning of stakeholders within the hierarchy of responsibility is given in the flowchart below.

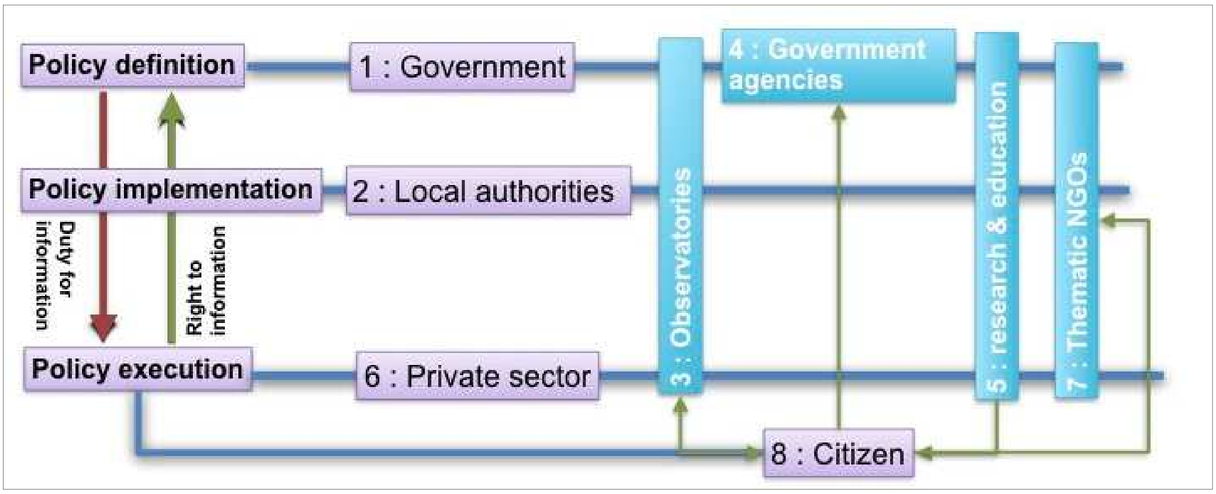

Illustration 2: Position of stakeholders within the levels of policy action.On the left : two arrows for defining the duty and right for information. Vertical boxes shows stakeholders working on the three levels,
Green arrows show the relations of citizens with the other categories.

Table 2: Stakeholder decision making criteria

Stakeholder behaviour	Stakeholder decision making criteria
Finality and objectives	Externally imposed or self-defined finalities and objectives
Worths	Own worths orientating and motivating its decisions
Regulations and norms	Regulatory and normative context of its actions
Facts and data	Reference facts and data, from environment or own experience
Models	Models or information processing tools for supporting its decision-making.

Using these criteria for each network of stakeholders, compared to what exactly has occurred during a disaster may help to understand the interactions between categories of stakeholders. From this understanding, it is possible to identify incoherence and conflicts between these categories, and therefore propose measures to prevent them.

This can be done in general or concerning a specific case, like the establishment of a DRR strategy on a given territory. It is felt also that using this method can help identifying information requirements for categories of stakeholders, which is one key aspect of the project.

The tables here below provide a few examples, based on return of experiences from important disasters:

- **Government office, as crisis manager:**

Table 3: Government office as crisis manager

Government service behaviour	Finalities and Objectives	Worths	Regulations Norms	Facts Data	Models
Ideal	Ensure safety of persons and goods	Safeguard of communities	Laws and regulations for managing disaster	Information from a network of territorial stakeholders	Hierarchy of needs based on safety of persons and goods
Observed	Ensure safety of persons and goods	Territorial and time priorities depends on the decision maker	Complexity of le legal and regulatory system : loneliness of the decision maker	Tools exists, but depending on telecoms and energy networks	Procedures and plans inoperative without telecom an energy: loneliness of the decision Maker

- **Local authority (Mayor), as crisis manager:**

Table 4: Local authority as crisis manager

Local authority behaviour	Finalities and Objectives	Worths	Regulations Norms	Facts Data	Models
Ideal	Answer citizens demands and minimize legal challenges	Service to citizens and management of the community image	Laws and regulations for managing disaster	Damage assessment based on territorial knowledge	Hierarchy of priorities based on territorial context
Observed	Accounting specific community characteristics,	Accounting particular interests detrimental to	Partial knowledge or legal and regularity obligations.	Very few real time situation inventory. Insufficient	Inefficient community safeguard plan. Very few flash

	lobbying for the definition of priorities	general interests	Family father management privileged	communication tools	flood anticipation

- **Network operator, as service provider:**

Table 5: Network operator as service provider

Network operator behaviour	Finalities and Objectives	Worths	Regulations Norms	Facts Data	Models
Ideal	Distribution of a service (water, electricity, telecom…) according to contractual and regulatory engagements	Ensuring public service within economic conditions accounting environment, competition, etc.	Priority needs to be satisfied as defined in the law	Gathering of information for a better evaluation of impacts on the territory and define priorities	Knowledge and follow-up of consumption an of user needs
Observed	Focus on the delay for service restoration, less attention given to quality	Accounting specific targets and economic criteria to ensure service continuity	Focus on answers to vital activities detrimental to the satisfaction of priority needs	No territorial focal point	Ignorance of territorial needs and territorial priorities

- **Citizen, as disaster victim:**

Table 6: Citizen as disaster victim

Citizen behaviour	Finalities and Objectives	Worths	Regulations Norms	Facts Data	Models
Ideal	Physical a financial protection of persons and goods	Strength of collective actions	Laws and regulations for citizen protection, NGOs regulations	Damage to persons and goods, indemnity	Precaution principle and lobbying
Observed	Non objective indemnity demands	Emergence of individual interests	Systematic search for public liability	Non objective choice favouring a lobby	Fundamentalist use of the precaution principle

This enables to understand individual stakeholder behaviour within a crisis situation. It also gives some indications on what is missing to each stakeholder category for making the observed coincide with the ideal. But the second step of the analysis consists in studying the mutual behaviour of stakeholders in order to identify what in this mutual behaviour may induce situations generating dysfunctions able to induce dangers.

A rough tool for these analyses consists in the superposition of the analysis grids given above. Focusing on the problem of networks, this has led, for example to identify points like:

- Incoherence between the legal, normative and contractual references of Government offices and network operators;
- Communication gaps between Government offices and operators;

- Information dissemination gaps from operators to the citizen, whose expectations are often not clearly stated;
- Underestimation of management difficulties of rescue material stocks between operators and authorities in charge of repartition;
- Lack of adaptation of Government offices' models to the specific needs of citizens and local authorities;
- Lack of co-ordination between stakeholders in the definition of safeguard plans, and later training.

This analysis of what has happened during a crisis enables to propose actions principles aimed at reducing the dissonances between the stakeholders, far upstream of any crisis, when defining a DRR strategy on the studied territory. This may lead, for examples, to identify what may be named "keystone stakeholders", in the sense they can federate the actions of stakeholders groups. For the case of "networks", have been so identified, the regulation authorities, the professional federations and... the academic community! The latter may appear in any case, as able to link the resilience concept to the modelling of systems.

4.1.5 Procedural Gaps and Legal Frameworks

One element that has been pointed out by feedbacks of NGO interventions (e.g. Red Cross National Report) in terms of cross-border crisis management concerns the procedural difference among nations in employing professionals in neighbouring countries.

4.1.6 Mismatches

Temporal mismatch is considered a major aspect also in France as:

- Climate change is committed by past greenhouse gas emissions until about 2050 (some of the impacts cannot be avoided) (see Clark et al. 2016 as an example)
- Climate change after 2050 depends on today's greenhouse gas emissions (see IPCC projections)
- Disasters can happen at any time

So finally, we have to decarbonize the economy now, in order to limit further increase of risks after 2050. Meanwhile, a disaster can happen tomorrow. Not surprisingly, the priority is given to:

- what citizens can see today (limiting today's high impacts events, DRR)
- low-cost actions (adaptation at cost zero, such as the national adaptation plan in France, or the mainstreaming of climate change adaptation in existing policies).
- Conversely, the urgent and very costly transition to a low carbon economy is constantly postponed to the decade after (e.g., atmospheric greenhouse gas concentrations have reached their highest point in 2016)

Concerning knowledge, several aspects have been pointed out:
The DRR community works from the beginning with an operational objective for regulations and plans and the R&D support follows. CCA community is primarily a research community and it is only recently that operational objectives have been introduced (e.g. the energy transition law).

Generally, there is no spirit of competition between DRR and CCA communities, but some differences in the priorities of each community could be detected:

- DRR communities want to reduce risks as soon as possible;
- CCA communities want to reduce greenhouse gas emissions as soon as possible, in order to limit climate change to a scale where adaptation is possible;
- CCA and DRR communities acknowledge that regarding adaptation to climate change, there is more time for concertation and implementation.

A a positive evolution over the past years in France, one can outline the parallel development of DRR and CCA issues and more and more cooperative projects undertaken between the two communities (e.g. the National Report on Climate Change in France where DRR and CCA communities have provided common assessments on future risks in a changing climate).

4.2 Challenges/gaps related to RISK in the existing legal/policy and science approaches

4.2.1 Risk Perception

One of the most recent published studies concerning the risk perception of the general public in France, a survey in 2013 by polling firm IFOP, found that 78% of French people were unaware of what to do in the event that France's national alert system is triggered, and 63% didn't know the risks that their geographical location exposed them to.

Risk perception is regionally very heterogeneous but has been considerably improved in some regions highly exposed to various hazards. Generally, the perception of risk in a territory is strongly related to the hazard occurrence and existing risk culture. It has been observed to be difficult to raise when no event has occurred.

Concerning the DRR and CCA research communities, there have been efforts to converge on these topics nationally (e.g. Jouzel reports) and internationally (IPCC SREX report). However, the variability in understanding risk is possibly larger within each community than on average when comparing the mean perception of the two groups.

4.2.2 Risk Assessment

Risk evaluation at national and regional level based on natural hazard data and available information on vulnerability is realized in France and institutional engagement is strong. However, some aspects are still limited and incomplete. This is the case concerning national multi-risk assessment data: not all schools and hospitals have been evaluated in the sense of providing all the information necessary to integrate them into planning and development decisions. A list of schools potentially vulnerable to disasters is still not available. Another challenge remains the standardisation of the risk evaluation. At present, the evaluation follows user-defined standards. All data is made accessible via the ONRN platform. However, data is aggregated by region (*département*) and larger scale information (commune, municipality) is not disseminated.

Systems are in place to evaluate, archive and disseminate necessary information on hazards and vulnerability (Natural Hazard Preventative Plans, post-disaster feedback reports, the national platform PPRIM, annual records of the Plan Séisme Antilles program). Existing database of impact and loss due to disasters are updated regularly. This data in combination with GIS is used to produce reports on a regular basis for government ministries (finance, planning and others). A remaining challenge is to be noticed at regional and local level in terms of a regular update of natural hazard evaluations. At present, there is no follow-up of natural hazard assessments and risk evaluation at regional or sub-regional level.

4.2.3 Crisis management feedback

Interpreting available literature and interview data, some difficulties related to the practical realization of crisis management reports can be determined. The feedback report is strongly influenced by the evaluation of responsibilities and is not sufficiently formalized.

4.3 Challenges/gaps related to SCIENTIFIC FRAMEWORKS in the existing legal/policy and science approaches

The interdisciplinary approach is increasing in the development and implementation of risk management plans. It is facilitated by the introduction of rules for accounting CCA in DRR plans.

Interdisciplinarity is also an issue in decision-making processes at different levels.

At national scale, the decision to implement a national adaptation plan comes from an interministerial group (see RNACC report above) and a concertation among all stakeholders (public bodies, ministries, NGO, scientists…) within the "Grenelle de l'Environnement". It can be seen as interdisciplinary.

At regional scales, this depends on the context. For example in the Aquitaine region, the interdisciplinary ACCLIMATERRA group of scientists is currently writing a report on climate change impacts http://www.acclimaterra.fr/. However, such dynamic effort is an exemplary exception rather than the norm.

At local scales, the PPR (risk prevention plans) involve scientists or engineers from consulting companies, the state and regional administration, municipalities as well as citizen (consultation phase). To some extent, this can be seen as multidisciplinary.

4.4 Challenges/gaps related to COMMUNICATION in the existing legal/policy and science approaches

The existence of communication barriers concerning concepts and terminologies) **between CCA and DRR communities** has been confirmed in the undertaken interviews and is also highlighted in the scientific literature (e.g. Romieu et al., 2010).

Communication difficulties have also been outlined among the academic community and practitioners (theory vs practice). As a thematic example can be cited the difficulties to understand and communicate uncertainties (e.g. Hinkel et al., 2015; Le Cozannet et al., 2015, 2017). This is a recurring barrier reported in any of the practitioners meeting that needs to be overpassed. However, there is a general consensus about the need for "mediators of science" towards practitioners, in particular local authorities and their staff.

The communication difficulties between practitioners and academic community have also repercussions in terms of the transmission of information to the general public (ex. http://france3-regions.francetvinfo.fr/normandie/seine-maritime/pays-de-caux/dieppe/prevention-risques-naturels-maires-mecontents-pres-du-treport-seine-maritime-1190787.html). Practitioners and general public are in the same situation facing the academic and engineering language. Confidence is the key for a good communication between practitioners and the public. Practitioners can only inspire confidence when they master and understand themselves the scientific issues. This requires education efforts towards both communities.

At present, there is no adequate dissemination strategy of best practices in terms of DRR, CCA and crossborder crisis management. It depends essentially on good will and personal relations. Bodies like ONRN and AFPCN are important role players in terms of promoting the exchange of good practices.

Another issue related to communication is the language barrier which is in particular a challenge working with nation states for crossborder crisis management.

The French Red Cross cites in its annual report the feedback of a number of border SDIS (who are accustomed to working with foreign relief teams), to have raised the problem posed by language. This problem can be resolved more easily at the cross border level as we shall see further on. In practice, in the field where the international relief team mission leader is the only person to receive instructions makes communication is relatively easy.

However, one or more interpreters have to be found quickly, depending on the number of relief teams arriving in the country in the event of a disaster. This would appear to be the ideal solution when neighbouring relief teams undertake, alone, missions in a given area. However, this solution seems to cause problems when border teams cooperate in the same area, while the language problem is heightened when different working methods and techniques are applied.

Therefore, solid grounding in the methods used in neighbouring countries would help to overcome the language problem and this knowledge could be acquired in meeting spaces or through training and regular drills. This training and these drills may not be required in some cases where relief teams are used to working together.

Efficient cooperation relies on a good knowledge of foreign relief team working techniques, means and methods. Additionally, coordination will become easier when certain working habits are put in place. Indeed, if this information is available and if practices and methods are known, this will enable authorities to submit precise requests and also to better identify the Governments that could intervene, thus saving a considerable amount of time.

Some SDIS Directors recommend the creation of meeting spaces for use in exchanging the practices and methods deployed in different countries. Furthermore, in terms of cross border cooperation (which we shall discuss in greater depth in the following development), it is worthwhile quoting the case of the Upper Rhine Conference whose purpose consists in investigating any cross border issue and in submitting solutions designed to improve cooperation, especially in the event of a disaster.

Working groups have been created and, in particular the following group: “reciprocal assistance in the event of a disaster”, which concentrates on “optimising pooled information and cross border cooperation between administrations and relief teams responsible for civil protection”. One of this group’s projects consists of the production of a bilingual dictionary in several volumes (two to date) specializing in civil protection terms 25 together with a description of general staff and their organization. The first volume takes the form of a document intended for intervention units while the second addresses the organization of the assignment at the scene of the event.

Besides the language barrier, communication difficulties are also likely to compound the challenge to manage a transboundary crisis, especially when there is no established, high-status organization that can act as a hub for information collection and dissemination. Response organizations often develop dedicated systems of communication, specialized for their purposes. These dedicated systems typically produce communication incompatibilities across response organizations (9/11 Commission, 2002; Snook, 2000). In addition, information is likely to flow most easily between jurisdictions and between organizations that have had frequent or routine contact as a result of previous events. Prior interaction is likely to create channels of both informal and formal communication (Kapucu, 2006). Yet transboundary crises bring together jurisdictions and organizations that have not been frequent collaborators.

5 Conclusion & recommendations

5.1 Conclusion

To conclude, it appears that the framework for conceiving and implementing disaster risk reduction and climate change adaptation strategies is inherently complex. This is due mainly to (i) the variety of these risks, which demands the diversity of specific regulations, (ii) their exceptional sophistication, sometimes difficult to understand, and consequently (iii) the associated difficulty to implement a global regulation.

In fact, it seems difficult to formulate a common frame of reference for e.g. a commune of the Alps exposed to the risk of avalanche, a commune in Guadeloupe located in a seismically highly active area or a commune exposed to flood risk. Another parameter determining the complexity is the changing nature of the regulation. This is depending on two aspects. Firstly, the consistent improvement of methods and technologies enabling to better perceive the hazard and associated risks as well as reducing impacts in case of occurrence. And second, the increasing knowledge about hazards and risks also influences the opinion on natural disasters and the associated consequences for regulation.

It is frequently the occurrence of a disaster, which leads to a rethinking of existing regulations. In France, the severe flooding in the Gard area in 2002 has led to a reconsidering of the prevention strategies for floods. More recently, in 2010, the storm Xynthia served as a wake-up call concerning the insufficient existing prevention strategies against marine submersion. As a consequence, the coastline urbanization plans were reconsidered, early warning systems overthought and a strategic plan for dykes was elaborate. This plan aimed at rebuilding or reinforcing the approximately 1,200 km of dykes along the coast, but also included the destruction of those that were not critical. In this context, the observed insufficient implementation of coastal risk prevention plans has led to accelerating their deployment and encouraging the update of these plans also for other natural hazards.

This example and the findings illustrated in this report make clear that present regulation in France is far from being exhaustive. Evolving technology and the inevitable occurrence of future hazards that will demonstrate needs for readjusting regulation to the reality of the situation in the field will undoubtedly lead to new considerations.

In this context, issues related to information and knowledge seem to represent an essential part of the challenges and identified gaps outlined in this report.

These will have to be taken into account in future adjustments of the framework for disaster risk reduction and climate change adaptation.

Example box:
The Upper Rhine Franco-German-Swiss region constitutes a shared living, commercial and cultural area for its inhabitants. The different cultures and traditions form the wealth of this region located at the heart of Europe and under no circumstances do they constitute obstacles. The Upper Rhine Convention was created with a view to encouraging cross border cooperation in this region. This is a "privileged framework for cross border dialogue within the Upper Rhine space". Working groups addressing a specific topic promote cooperation in a number of areas and especially in the field of mutual assistance in the event of a disaster affecting this region. For example, since 1987, firemen from Kehl (Germany) and Strasbourg (France) have joined forces in preventive firefighting and for exchanging information and experiences.

Another example is how the River Rhine is extremely important to the Upper Rhine region as it is used by vessels to carry increasingly large amounts of hazardous products and river cruises are proliferating, resulting in increased risk. This led to the decision to acquire a Europa 1 firefighting tender vessel, which is managed (maintenance and operation) by a local cross border cooperation group. However, this does not involve combined relief teams and they run the vessel alternately with the French firemen using it during the day and their German counterparts nights and weekends.

Generally speaking, the spirit and the content of the guidelines set out by the Federation feature in the bilateral agreements, with a lack of formalism identified in some fields, with no obstacles in terms of the cooperation that could not be adapted according to the case in question. However, it was clear that there was a need to make up for this lack of formalism in terms of customs procedures and in certain cases of cross border cooperation. Furthermore, by virtue of its nature and areas of competence, the European Union has made it possible to lift a number of barriers such as those affecting border crossings.

5.2 Recommendations

The French Insurance Federation has published in 2015 a white paper entitled "For a better Prevention and Protection against Natural Hazards". This extremely valuable document relies on a review of feedback reports of the past 25 years and perspectives of the 25 coming years in order to formulate precise propositions concerning the two main pillars of climate and natural hazard related risk management that are prevention and insurance.

In the context of the existing dysfunctioning and in view of improving coherence and efficiency of prevention and protection strategies, 23 propositions for improvement of public policies have been highlighted. In addition, 11 propositions aimed at preserving solidarity via the promotion of prevention and the development of a risk culture have been published.

These propositions are cited in the following: the first part focuses on propositions for public prevention policies for natural hazards and the second part concerns improvements of the insurance regime for natural disasters (source: French Insurance Federation, 2015).

5.2.1 Public policies for the prevention of natural hazards

Natural Risk Prevention Plans (PPR) that have been prescribed but not approved:

- Carry out detailed six-monthly monitoring, département by département, of the state of progress of prevention plans that have been prescribed but not yet approved. To entrust this task to the major risk committees (conseils des risques majeurs) of the départements, which will make their findings public.
- Build a reference model for rating the relevance and effectiveness of approved Natural Risk Prevention Plans (PPRn) and to entrust it to the National Observatory for Natural Risks (ONRN).

Obsolete Natural Risk Prevention Plans (PPR):

- Put in place an obligation for any municipality that has an older generation's prevention plan to update it within a period of 36 months.

PPRs not attached to town planning

- Draw up a list of municipalities that have a Natural Risk Prevention Plan that is not attached to its Local Development Plan.
- Make the financing of a flood Prevention Action Programme conditional upon the relevant municipalities including the Flood Risk Prevention Plans in their Local Development Plans.

Too much diversity in the format of PPRs

- Build and implement a single data repository, common to all PPRs providing in particular for them to be made available in digital form including the map layers.

Delays in implementing the rapid flooding plan and inadequate deployment of coastal risk prevention plans in at-risk municipalities

- Accelerate the process of prescribing, approving and implementing Coastal Risk Prevention Plans for priority municipalities where a plan has not yet been prescribed or, if prescribed, has still to be approved.
- In the absence of such plans, to apply the precautionary principle by imposing a systematic refusal to grant building permits for projects that are of such a nature as to adversely affect public safety because they are located in areas presumed to be at significant risk.
- Identify campsites that are at risk of flooding and require them to prepare, within a reasonable period of time, response plans to be implemented in the event of a warning of river or coastal flooding.
- Require municipalities at risk or rapid flooding to put in place public warning systems based on modern communication methods (text messaging, email and social networks).

The total lack of municipal plans in too many towns

- Prohibit municipalities that do not have a Municipal Response Plan from accessing the resources of the Major National Risk Prevention Fund.

Certification and financing criteria for flood prevention action plans need further improvement

- Improve the eligibility and prioritisation criteria for financing of Flood Prevention Action Programs.
- Share the experiences of the certified Flood Prevention Action Programs.

Specific hazards

- Strengthen public prevention policies giving little consideration to drought risk: this includes for example to make it compulsory for soil analyses to be carried out for all building projects or sales of land that has been or is authorized to be built on, located in areas that have been identified as being at risk, and for the analysis to be attached to the notarised deed for the land.

Funding

- Increase the coherence and efficacy of funding mechanisms for prevention policies. This can be done for example by

- Task the Orientation Committee for the Prevention of Major Natural Risks (COPRNM) with ensuring the proper coordination and coherence of all the resources assigned to the prevention of natural hazards.
- Reform the Major Natural Risk Prevention Funding terms of its governance, its tasks, its oversight and control of its expenditure.
- Establish a closer relationship between the Major Natural Risk Prevention Fund and the public authority bodies responsible for deciding and prioritising preventative actions, such as the Joint Flood Committee.

A lack of information and warning systems for the general public

- Put in place new tools for the general public (website, smartphone app) in order to disseminate knowledge about exposure to and prevention of natural risks, to entrust this task to the National Observatory for Natural Risks.
- Introduce a national natural risk prevention day having the following aims: to provide information to people situated in risk areas and to educate people in the correct actions to take if an extreme climate event occurs.

5.2.2 Modernisation of the natural disaster insurance regime

Variation of excesses

- Introduce in the national disaster insurance regime the freedom for the insurer to set the level of the excess for this cover for insurance contracts covering capital amounts in excess of 50 million Euros and those covering regional and local authorities whatever the amount.

Transfer of the drought risk to the new buildings liability insurance regime subject to certain conditions

- Transfer the compensation for losses resulting from drought to the ten-year building liability insurance regime for all new buildings that satisfy the requirement for soil surveys.
- Accompany this transfer with preventative measures linked to the obligation to carry out soil surveys and with a limitation on application of the natural disaster insurance regime, which will be restricted to damage affecting the soundness of the building's structure after 10 years.
- Make it compulsory for the insured party to use the compensation paid by the new building liability insurer to repair the building or the land on which it is located if the building is to be rebuilt on the same site;

Simplification of the statutory variation of the excess

- Simplify the mechanism for varying the excess by limiting the consequences of such variation for insured parties and requiring a Natural Risk Prevention Plan to have been approved and Municipal Response Plans put in place in order to avoid application of the variation.

Defining more objective criteria for official natural disaster declarations

- Establish an objective basis in law for the scope of application of natural disaster cover by listing the perils covered and describing the criteria governing the levels of seriousness.

Including alternative accommodation costs

- Include in the natural disaster insurance regime compensation for the costs of alternative accommodation for victims of natural disasters whose main residence has been damaged.

Extending the deadline for notifying claims

- Extend the deadline for notifying claims following a natural disaster from 10 to 30 days.

Including a section specific to businesses in natural risk prevention plans

- Make it compulsory for NRPPS to include a section dedicated to the prevention of business risks and to monitor its implementation.

Formalising the role of ONRN

- Promote the role of ONRN in disseminating a culture of awareness of the risks associated with natural events.

Reform of the “Natural Disasters” section of the central pricing office

- Give the natural disasters section of the Central Pricing Office complete freedom to set the conditions of insurance (price, excess, protective and preventative measures).

5.2.3 Crossborder cooperation priorities

The country report by the French Red Cross published in 2010 in the framework of the EU IDRL study “Analysis of law in the EU pertaining to cross-border disaster relief”, outlines the following issues as transboundary cooperation priorities:

International cooperation in cases of disaster in most countries is currently managed by bilateral or multilateral agreements. These treaties offer certain flexibility. In spite of common traits between each one, there are different systems and procedures applied in each country.

The creation of a single set of procedures within each country in relation to international relief in situations of disaster would help to resolve this difficulty and help give clear direction to the different actors concerned. For example, visa exemptions could be granted systematically to international relief teams if prior agreement for entry into the country has been approved by the government, a privilege that is not specified in all treaties. Another way in which the treaties vary concerns the focal points which can vary between the Ministry of the Interior and the Ministry of Foreign Affairs.

Assume that the consequences of a disaster would surpass the affected country’s capacity response and demand specific equipment that official partners don’t have or do have but in limited capacity. This situation would force the affected country to ask for help from other countries where no agreement has been signed previously: instead of taking exceptional measures in a crisis context, the implementation of a single set of procedures could anticipate those situations.

Then, about the capability to respond to disasters, it could be interesting to expand the scenarios further in order to confront the reflection on situations with the biggest consequences that we are used to doing currently, situations where each country’s response capacity would be limited in order to examine all the alternatives, such as the call for international relief. That is why being legally prepared before a time of crisis is all the more important.

In addition, it would be helpful to democratize the simulation of exercises, which have the advantage to be cheaper than a real exercise on the field. It would facilitate the gathering of a bigger number of national and international actors, for a reasonable period of time and thus, encouraging the sharing of experience, information, knowledge of the equipment held by our partners and cooperation more frequently.

It would also be more coherent to broaden the recognition of qualifications of the first aid workers coming from abroad, at least the ones who come from Europe. For instance, the French Red Cross is allowed to call on the first aid workers of the International Movement of the Red Cross and Red Crescent but cannot use their help if they do not follow an 8-hour training provided by the French Red Cross. In times of crisis, it is impossible to provide this training.

Finally, the States have a role to play in the trans-border cooperation, the foreign policy being a State competence. The regions, the decentralized structures, cannot deepen their crossborder relations without a state initiative. There is no well established framework within some crossborder regions today about the rescue operations. The question of the liability is not therefore solved. It is necessary to encourage the implementation of administrative agreement between the French and the crossborder departments when there is a lack of competence in foreign affairs.

More precisely, the following activities have been identified as priorities for cross-border cooperation:

- Fostering of the integrated watershed management approach and the consideration of integrated natural hazards and risk management strategies in all planning processes relating to land-use and the use of natural resources.

- Implementation of hazard zone maps in land-use planning and land use management

- Promotion of local object protection measures and individual responsibility in relation to natural hazards.

- Further development of already successful coordination and collaboration between all responsible institutions at both regional and transnational level.

- Increasing the involvement of the public in the planning of permanent mitigation measures, improvement of the individual responsibility and of the awareness of populations in establishing a culture of safety and resilience at all levels.

- Reinforcement of disaster preparedness through local emergency training. Elaboration of strategies for the reinstatement activities during and after an extreme event.

- Improvement of early warning services.

- Enforcement of sustainable solutions in the context of protection and risk reduction strategies. Consideration of damage potential, risk analysis and cost-benefit analyses in integrated risk management. Planning of permanent protective measures on the basis of a list of priorities over a long-term planning period rather than as reactions to events that cause damage.

- Integration of a multi-risk approach in the territory development.

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Annexture 04

ESPREsso

Enhancing Synergies for disaster PRevention in the EurOpean Union

Synthesis report of legal, policy and science approaches within the frame of Disaster Risk Reduction and Climate Change Adaptation

Swiss National Report

ESPREsso Deliverable 2.1
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April, 2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 700342. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein

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Introduction- Framing the issue

This report serves to add a Swiss perspective to the wider aims of ESPREssO (Enhancing Synergies for disaster PRevention in the EurOpean Union) specifically for its Work Package 2- developing a theoretical framework to address the challenge of integrating Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) by analyzing, synthesizing and comparing existing knowledge of legal, policy and science approaches. As an input paper focusing on the Swiss system, this national-scope report focuses on how ESPREssO's 3 challenges are addressed at the national level. It will help inform a European-level paper (based on inputs from national reports from UK, Italy, France, Switzerland, Denmark and Germany). A global review paper in turn will synthesize existing gaps related to the challenges in the six countries and reflect on how to integrate them into a consolidated list of priorities. The three ESPREssO challenges are explored below, along with the global policy context.

What is a Disaster?

The term 'Disaster' is defined as serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UNISDR, 2007). In general, disasters can be categorised into two main types: natural disasters and manmade disasters (Brun, 1992). The origins and causes of these disasters may differ, but the consequences are more or less the same, which include loss of lives, economic losses, destruction to the built and natural environment, and disruption to local institutions and livelihoods (Haigh & Amaratunga, 2010).

What is Disaster Risk?

UNISDR (2007) defines disaster risk as the potential disaster losses, in lives, health status, livelihoods, assets and services, which might occur to a particular community or a society over some specified future time period. Disaster risk can also be identified as the expectation value of losses (deaths, injuries, property, etc.) that would be caused by a hazard. Accordingly, disaster risk can be seen as a function of the hazard, exposure and vulnerability (Kitamoto, 2005).

What is a Hazard?

A hazard is a potentially damaging physical event, phenomenon or human activity that may cause loss of life or injury, property damage, social and economic disruption or environmental degradation (UNISDR, 2015b). Vulnerability is the characteristics and circumstances of a community, system or asset which make it susceptible to the damaging effects of a hazard (UNISDR, 2007). 'Exposure' is the third component which creates disaster risk, and refers to that which is affected by natural disasters, such as people and property (Kitamoto, 2005).

Disaster risk is an outcome of these three key factors and the integrated effect of these three factors can be identified as the mechanism behind the emergence of natural disasters. In order to reduce disaster risk, the concepts of DRR and CCA have emerged.

What is Disaster Risk Reduction (DRR)?

There are different perceptions on emergence of the concept of DRR. As Wisner et al. (2012) highlight, the concept of DRR emerged from the concepts of emergency management and disaster management. Initially, emergency management and disaster management were key concepts to reduce risk and vulnerability. However, due to limitations of the disaster management concept, in dealing with increasingly frequent and complex disasters, international frameworks began to replace disaster management with the concept of disaster reduction, and later disaster risk reduction (Tabish & Syed, 2015).

Many DRR policies and strategies view disasters as socio-economic and political in origin, reflecting a school of thought established in the 1970s. They consider the wider social, political, environmental and economic environments in which a hazard is situated. This is in stark contrast to previous views of disasters as unavoidable 'natural events', which needed to be managed. Since disasters are created by the wider social, political, environmental and economic environments, they can be managed and reduced by the wider social, political, environmental and economic actors (Blaikie et al. 2014).

DRR refers to a wide range of opportunities for risk abatement and disaster management. Risk reduction includes prevention, preparedness, and part of the recovery process. It gives particular emphasis to reduction of vulnerability (Alexander, 2013; Ammann, 2013).

UNISDR (2007) defines DRR as: *"The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events".*

What is Climate Change Adaptation (CCA)?

Climate change policy negotiations initially focused on an urgency to address the origins of climate change, i.e. focusing on reducing greenhouse gas emissions from human activities. Whilst this remains an essential activity, climate change impacts at the local level are becoming a reality (Kelman, 2008; UNFCCC, 2007). As a result, international policy discussions began to focus on a need to 'adapt' (Stalker, 2006).

IPCC (2012) defines CCA as: *"The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities".*

The concept of CCA is broad and CCA strategies aim to reduce vulnerability to expected impacts of climate change. CCA strategies exist across local and global scales, from community level responses to regional, national and international government interventions (UNFCCC, 2006). At the community level, strategies include improvements to agricultural systems, such as crop diversification, or introduction of hazard resistant crop varieties; risk assessments and associated plans; protection of natural resources; early warning systems; education and awareness measures and protection of water resources (Stalker, 2006). At the national level for less developed countries, some have National Adaptation Programmes of Action (NAPAs). NAPAs identify areas in which adaptation strategies are essential in mitigating against adverse climate change effects (UNFCCC, 2007).

The Global Policy Context

Currently, there are several global policies in action in relation to CCA and DRR. There are three key global policies which work on CCA and DRR:

Paris Agreement

At the Paris climate conference in December 2015, 195 countries adopted the first ever universal, legally binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C (European Commission Climate Action, 2016). The Paris Agreement shall enter into force on the 30th day after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession with the Depositary. The first of these thresholds was achieved on 22 September 2016 (UNFCCC, 2016).

Sendai Framework for Disaster Risk Reduction (SFDRR)

The SFDRR was introduced at the Third United Nations World Conference on Disaster Risk Reduction, held in Sendai, Japan in 2015. This framework provides a concise, focused, forward looking and action- oriented post-2015 framework for disaster risk reduction. This framework complements and replaces the Hyogo Framework for Action, while identifying gaps and challenges to be further addressed. As an action-oriented framework this can be implemented by governments and stakeholders in a complementary manner. The framework highlights the importance of disaster governance, stakeholder participation, and disaster preparedness against future disasters (UNISDR, 2015a). It emphasises the impact of climate change and its effects on disasters. The SFDRR focuses on a strategy that is a multi- hazard approach, covering disaster losses between 2015 and 2030. The aim of the framework is to achieve a substantial reduction of disaster risk and losses in lives, livelihoods and health; and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. This will be achieved through four priority areas (UNISDR, 2015a):

Priority 1: Understanding disaster risk. Priority 2: Strengthening disaster risk governance to manage disaster risk. Priority 3: Investing in disaster risk reduction for resilience. Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Sustainable Development Goals

The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. These 17 goals build on the successes of the Millennium Development Goals, while including new areas such as climate change, economic inequality, innovation, sustainable consumption, peace and justice, amongst other priorities. The goals are interconnected – often the key to success with one will involve tackling issues more commonly associated with another (UNDP, 2016). Climate Action remains the 13th out of 17 development goals. The goal aims to mobilize $100 billion annually by 2020 to address the needs of developing countries and help mitigate climate-related disasters. It aims to help more vulnerable regions, such as land- locked countries and island states adapt to climate change. The goal suggests to integrate disaster risk measures into national strategies (UNDP, 2016).

Framing the three challenges of ESPREssO:

Integration of CCA and DRR:

While interdependencies and synergies exist between CCA and DRR (Figure 1), practitioner and researcher communities dealing with these issues still seem isolated from each other (e.g. Gaillard 2010).

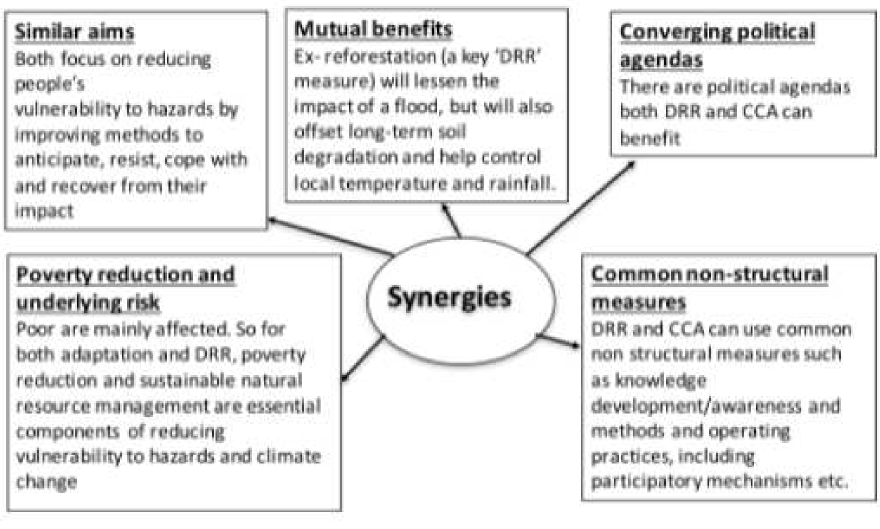


Figure 1: Synergies between DRR and CCA (ESPREssO Challenge 1 internal report, 2016).

On the one hand, it is still unclear how to achieve CCA outcomes through improved DRR policies, planning and risk management. On the other hand, it is unclear what added value CCA measures bring to existing DRR tools and plans. Effective integration of CCA with DRR requires participation of a wide range of stakeholders: policy makers, private firms, scientists, NGOs, and educators (IPCC, 2012; UNISDR, 2009). Multi- stakeholder and multi-sectoral processes are vital in building common understanding, commitment and consensus (UNISDR, 2009). However, coordination of these different stakeholders with different interests is one of the challenges of integration due to inability to reach consensus on specific adaptation measures (Lei &Wang, 2014). Decision makers, for instance, are interested in sourcing scientific information on climate change to support decisions regarding adaptation (Mastrandrea, Heller, Root, & Schneider, 2010).

Mostly top-down approaches are used in climate impact assessment, whereas bottom-up approaches are applicable in acquiring knowledge of vulnerabilities at a decision-making level. Developing an integrated approach to inform decision making has therefore become a difficult task (Mastrandrea et al. 2010). There are separate global and regional frameworks available for CCA and DRR (Sperling & Szekely, 2005b). Different institutions from different organisational cultures manage CCA and DRR differently. These organisational cultures generate separate agendas and frameworks, further hindering integration of DRR and CCA. (Forino et al. 2015). Table 1 provides a list of issues related to the challenges identified, which are further explored in a conceptual framework in Annex 1.

Table 1- CCA/DRR challenge: some open issues

Differential integration	What are the institutional frameworks to integrate CCA and DRR? What are the relevant criteria to compare and contrast different approaches? What are the steps to achieve effective integration? What are the priorities? What are the contextual factors affecting this process? How to identify different frameworks of "differential integration"?
Responsibility allocation	How can the present "single hazard" risk management regimes provide a fertile ground to reduce CCA/DRR separation? Why do the present institutional contexts discourage collaboration within and between levels of government? How to overcome a silo mentality?
Regulatory fragmentation and separation	How to bridge the gap between CCA international, often non-binding agreements and DRR national, regional and local often binding legislation?
Funding	Are there reliable databases available to have an overview and compare CCA and DRR funding, especially at the national and local level? Who should fund CCA and DRR integration, especially at the local level? Should new agencies be created? Do national and local authorities have sufficient financial capacities and human resources to do so?
Convergences and good practices	What are the areas of convergence between CCA and DRR? What kind of practices have been implemented? What practices are successful and why?
Partnerships	How to develop cross-sectoral partnerships to improve dialogue between CCA and DRR communities? What should be the mandate and focus of these networks?

Integration of national regulations in preparation for trans-boundary crises

Disasters frequently have cross-boundary impacts. Recent European cases include the Central Europe flood, affecting Eastern Germany and Hungary, extreme drought and a heat wave that hit several European countries in 2003 causing destruction of large areas by fire, and an earthquake that hit the French/ Italian border in 1995.

Experience shows that despite general tendencies to cooperate, as the number of stakeholders increases, so too does competition amongst them. Differing regulations either side of a border can hinder organisation of an effective response, creating something of a "no-man's land" or a more vulnerable area within the border zone itself. A rising number of public and private actors is a major complexity in disaster response and risk management (Schneider, 1992; Kory, 1998; Katoch, 2006). We explore this in the case of the Swiss-French border in Chapter 4.

An increase in the number of stakeholders and changing stakeholder backgrounds arguably has important repercussions on taking efficient actions in disaster settings (Telford et al. 2007). As Quarentelli (1997) notes, 'government and private groups may have different interests, tasks and goals'. However, whilst there seems to be general consensus about the growing number of actors, there is a surprising lack of in-depth analysis of the consequences of this and of the impact that so many actors may have on how humanitarian action is handled.

Existing national regulations are often conflicting and do not allow a harmonized approach to manage crises occurring between countries. This conflict is complicated by the increasing number of actors involved in disaster response, as well as increasing scales of operations responding to disasters. Existing mechanisms may require strengthening in order to provide effective support and achieve better implementation.

In a European context, over half of global funding provided to address the needs of people struck by disaster situations, is provided by the EU and its member states. Through its humanitarian actions, the EU provides disaster response, disaster preparedness and acts as advocate for international humanitarian law. In 2013, the Emergency Response Coordination Centre (ERCC) was inaugurated, its key mission being to provide operational support, integrated situational awareness and analysis for the coordination of actions through both humanitarian aid and civil protection instruments.

Integration of science with legal/policy issues in CCA and DRR

This challenge arises because of the now-crucial relationship between knowledge production and institutional responses required for disaster management. Scientific capabilities and institutional capacities to approach disaster management have not proceeded at the same speed up to now. Science has developed innovative concepts and tools that institutional capacities can hardly use under the current legislative framework. Typical examples are resistance to widespread use of early warning and multi-risk methods.

Better understanding of the relationship between knowledge production and institutional response is crucial to managing modern, increasingly complex disasters. Defining the role, tasks and responsibility allocation and distribution between scientists and practitioners is a topic that deserves more attention. In their role as advisers, scientists have emerged as a form of the fifth branch of government. But even though the growing dependence of regulatory agencies on scientific and technical information has granted scientists a greater influence on public policy, opinions differ as to how those contributions should be balanced against other policy concerns (Jasanoff 1990, 2007). Also, it is a dangerous assumption to make that "science" is always right. According to many scientific advisory committees, the role of science is to give all available information (expressed whenever possible in probabilistic terms) needed to emergency managers and policy makers to inform their decision-making. The final decision should be taken balancing scientific information with other types of evaluation (politics, socio-economics).

This report goes on to explore and focus on these three "integration issues" or challenges, in more detail, with Swiss policy and practice in mind. The results will feed back to a consolidated deliverable to help build a better picture of European synergies and gaps between CCA and DRR, envisioning a better way forward in terms of research opportunities and streamlining policies.

1. The Swiss Context

In socio-economic terms, Switzerland is a prosperous, highly-developed country with scope to adapt to a changing climate (Figure 1.1), possessing the skills, ability and willingness to innovate. Inter-sectoral cooperation, an insurance industry committed to actively informing individuals about risk prevention and a devolved, top-down approach of governance, all contribute to a system which has capacity to prepare for, deal with, and learn from, immediate disasters as well as more gradual climatic change impacts.

Compared to some other European countries, relatively few large-scale (or nation-wide) disasters have occurred in Switzerland's recent history. This means that where other countries might dramatically adapt, reform or innovate linking strategies within and between their CCA and DRR policies, through necessity; along with their decision-making processes and mitigation efforts based on lessons learned from earlier disasters, Switzerland has less call to prompt sudden reform or innovation. Instead, a recent report by The Organisation for Economic Cooperation and Development (OECD, 2017), describes Switzerland as a role model, pursuing "a forward-looking, whole-of-society approach to risk management, anchored in a philosophy that the state's efforts are only effective if all stakeholders contribute their share" (OECD, 2017).

Switzerland seems therefore to be in a relatively fortunate position of both preparedness and inter-connected policy-making, without suffering regular large-scale disasters, allowing somewhat of an opportunity to make advancements without the system being placed under regular pressure. Links between CCA and DRR have perhaps yet to be tested and with certain boundary conditions of strong federal and subsidiarity in civil protection (Prior *et al.* 2016), establishing a basis for systemic support for reform is sometimes difficult. This report attempts to look at both CCA and DRR in Switzerland and make recommendations for finding synergies between them.

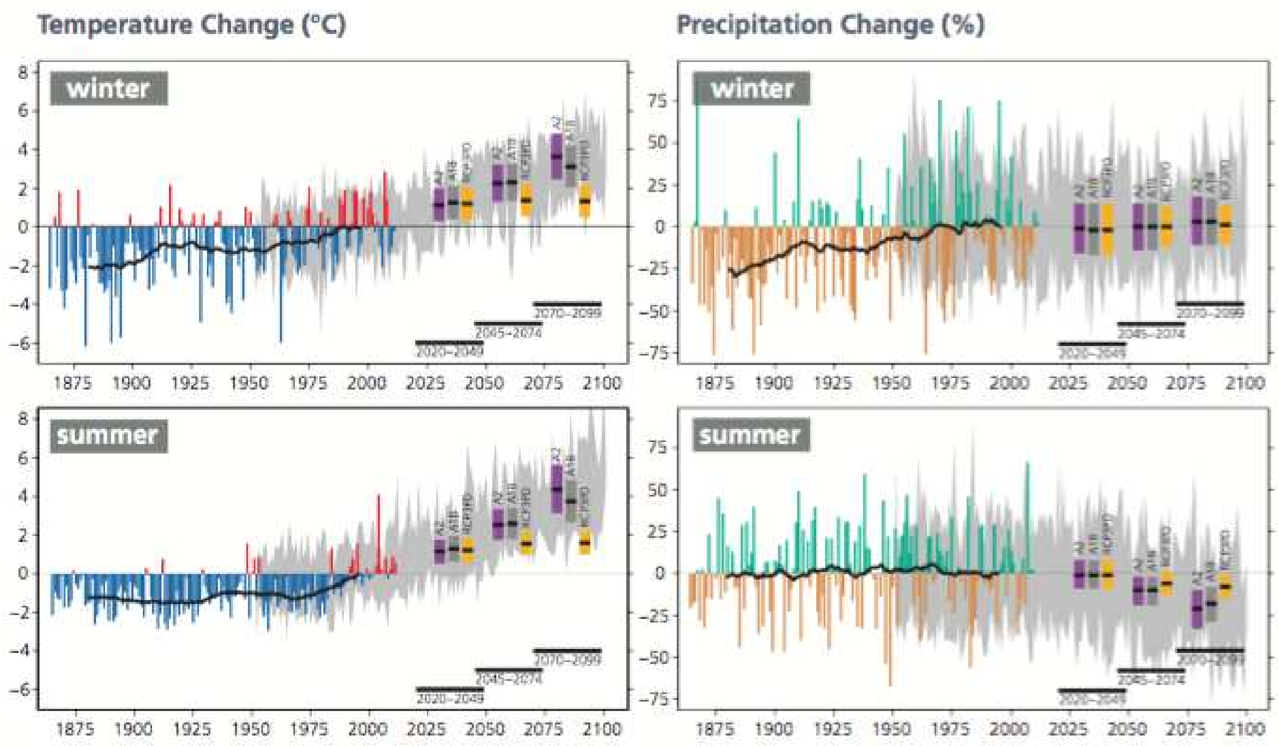


Figure 1.1: Past, present and predicted changes in Swiss climate (north-west Switzerland). CH2011 (2011).

1.1 Switzerland's geographical setting

Switzerland is a land-locked country, bordered to the north west by the Jura mountains and to the south by the Swiss Alps, its central plateau lying between (Figure 1.2). It shares its borders with 5 other European countries- France, Italy, Liechtenstein, Germany and Austria, all of which approach CCA and DRR in different ways. Lessons can be learned from these neighbouring nations, and vice-versa. This is one area for development *ESPREssO* intends to explore further, in terms of trans-boundary crises and how preparedness translates across borders. Considering that Swiss alpine glaciers feed several of the major trans-European rivers; notably the Rhine, Inn, Ticino and Rhône (OECD, 2017), it is an important context within which to frame the Swiss system.

Figure 1.2: Map of Switzerland, showing central lowlands and the Alpine region (FOEN, 2015).

1.1.1 Switzerland's changing climate

A significant rise in temperature in Switzerland is regarded as the most striking indicator of climate change in recent decades. Over a measurement period ranging from 1864 to 2012, a temperature increase of 1.75°C has been recorded (Federal Office for the Environment, (FOEN), 2015, Brönnimann et al. 2014). Overall, climate change in Switzerland is expected to increase the intensity of precipitation and storm duration, prompting a need for more climate change mitigation measures to limit the extent of damage caused by individual flood events, hail and severe storms. Figure 1.3 shows changing temperature and precipitation patterns in Switzerland.

Swiss snow line elevations are also responding to climbing temperatures, rising in all of the major resorts, putting economical pressure on Swiss ski resorts and prompting in some places, diversification of activities, to attract a stronger summer market to support a shortening winter season. This is of particular concern in lower-lying ski resorts in the *Voralpen* (fore-alpine region). A case study from the Toggenburg ski area (Wildhaus- Alt St. Johann, Canton of St. Gallen) will explore this in further detail in Chapter 4.

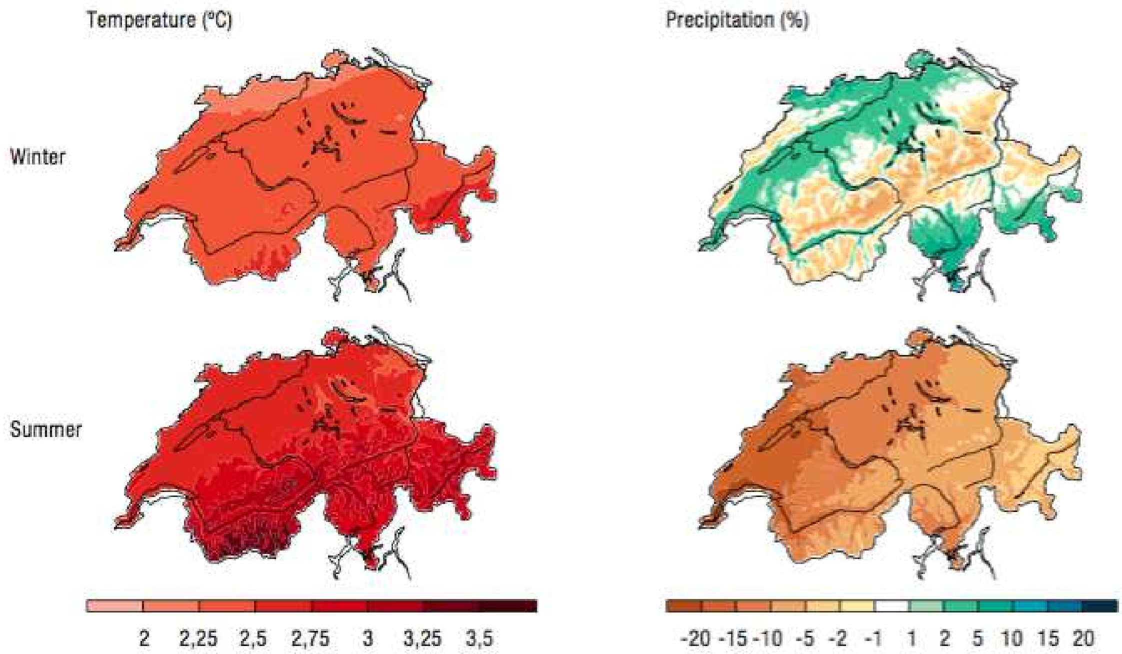


Figure 1.3: Temperatures and precipitation in Switzerland between Summer and Winter. An unbridled increase in global emissions until 2060 leads to striking changes. (Source MeteoSwiss, FOEN, 2014).

1.1.2 Switzerland's Population

Switzerland has a population of around 8.2 million people, of which, the majority live in the Swiss lowland. In addition to centres of industrial production, important services and the main road network, rail and aviation infrastructure, all of the major cities, i.e. Geneva, Lausanne, Bern, Lucerne, Zurich and Basel, are located there. With a population density of more than 600 people per km^2, the Swiss Central Plateau is therefore one of the most densely populated areas in Europe (FOEN, 2015). Switzerland is a strongly urbanized country with around 75% of its population (around 6 million people), residing in urban areas (Prior *et al.* 2016). Urban populations are also growing faster in Switzerland, than rural populations, reflecting similarly observed global patterns (Prior *et al.* 2016).[1] This growth has prompted a need for significant advancements in Swiss DRR over the last few decades.

1.1.3 Swiss emissions- human contributions to a changing climate

Switzerland's share of global greenhouse gas emissions amounts to just 0.1 percent, and with economic growth occurring in China, India, Brazil, and other economically-emerging countries, this percentage is steadily decreasing. However, as an economically advanced country, Switzerland has a duty to show it can convert to a "climate-friendly economic and social organisation, while maintaining a high quality of life" (Karine Siegwart, Vice Director, FOEN, 2014).

Changes in Swiss emissions can be seen between the years 1980 to 2010 in Figure 1.4. A steep upwards rise in greenhouse gas emissions, particularly after 1960, is attributed to an explosion in road traffic, personal motor car ownership and strong economic growth. While transport now accounts for almost one third of Switzerland's greenhouse gas emissions, in 1900 it was responsible for only 9 percent. Conversely, in just over one century, agriculture's contribution to emissions fell from 47 percent to 11 percent (FOEN, 2012a). Switzerland's emissions scenario, like other countries is a dynamic, moveable backdrop upon which to plan efficient Climate Change Adaptation strategies. Changing socio-economic drivers are capable of reversing otherwise strong trends, so adaptation measures must be able to keep up with these patterns in order to offset significantly negative impacts.

[1] United Nations Population Fund, http://www.unfpa.org/pds/urbanization.htm, accessed 22.01.2013.

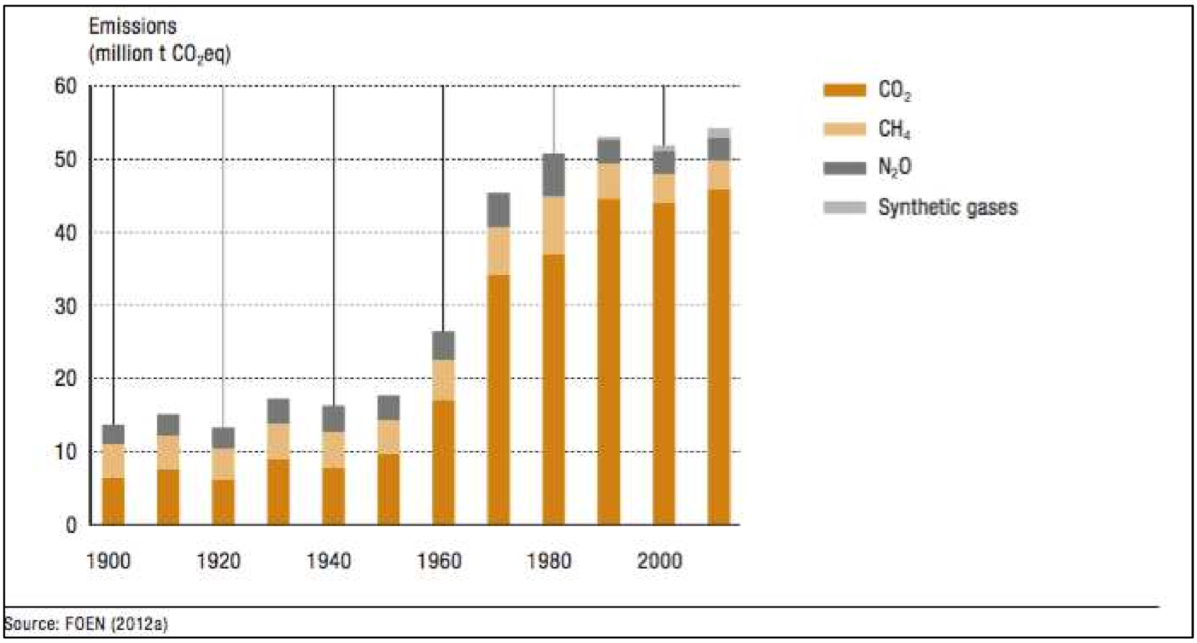


Figure 1.4: Evolution of greenhouse gas emissions in Switzerland between 1900 and 2010 (FOEN, 2012a).

1.2 Disaster Profile of Switzerland

Switzerland has high fluctuations in relief, ranging from the central lowland plateau a few hundred metres above sea level, to 4500m+ peaks. Switzerland's mountainous regions are vulnerable to a wider *range* of natural hazards than its Central Plateau. Associated hazards in these high relief areas, include avalanche, rock fall, debris flows and landslides, exacerbated by higher erosion rates in steep terrain.

Floods also pose a nation-wide threat due to high (and increasing) precipitation and periodic high run-off from upland areas sometimes causing build-up stresses further downstream. Switzerland has a vast watercourse network, whose combined length totals around 65,000 kilometres, and due to extreme differences in altitude over a relatively small area between the Alps and Central Plateau, floods can occur almost everywhere in Switzerland. In warmer periods, when seasonal snow and glacier melt in the Alpine region coincide with intensive storms, prolonged rainfall or orographic precipitation, rivers and lakes may break their banks and can flood valley plains (FOEN, 2015).

Intermittent, heavy snowfall and unstable snow pack can create a risk of avalanche at high altitudes, while heavy rainfall during the warmer seasons can trigger landslides and debris flows. Rock fall and landslides can put both settlements and critical transport routes at risk, demonstrated by the blocking of the Gotthard motorway, a key cross- Alpine road axis between northern and southern Europe, in 2006.

Climate warming in the Alpine region and the resulting thawing of permafrost and retreat of the valley glaciers causes de- stabilisation of slopes and availability of greater volumes of loose material to be mobilized in future, a development which represents an additional threat of rock fall and slope failure, to settlements, transport routes and other infrastructure. Climate change is also thought to lead to heat waves becoming longer, more frequent and more intense. Heat stress plans have been produced in urban areas where the effects are felt most strongly (e.g. Stadt Zurich) making advice available to the public for information. Drier periods are also expected to become more common. Longer periods of drought increase the risk of forest fires, particularly in the south of Switzerland.

Large earthquakes are a rare occurrence in Switzerland, however when they occur, they represent the natural hazard with the greatest potential for damage (FOEN, 2015). The Swiss Seismological Service (SED) at ETH

Zurich (ETHZ) is the federal agency in Switzerland responsible for monitoring earthquakes and assessing the seismic hazard of Switzerland. Overall, the seismic hazard level of Switzerland qualifies as intermediate at a global scale. On average, 10-15 earthquakes are felt each year within Switzerland, with damaging events expected every 5-10 years. Over the past 800 years, a total of 28 events of a moment magnitude Mw ≥ 5.5 are known to have occurred (SED, 2004).

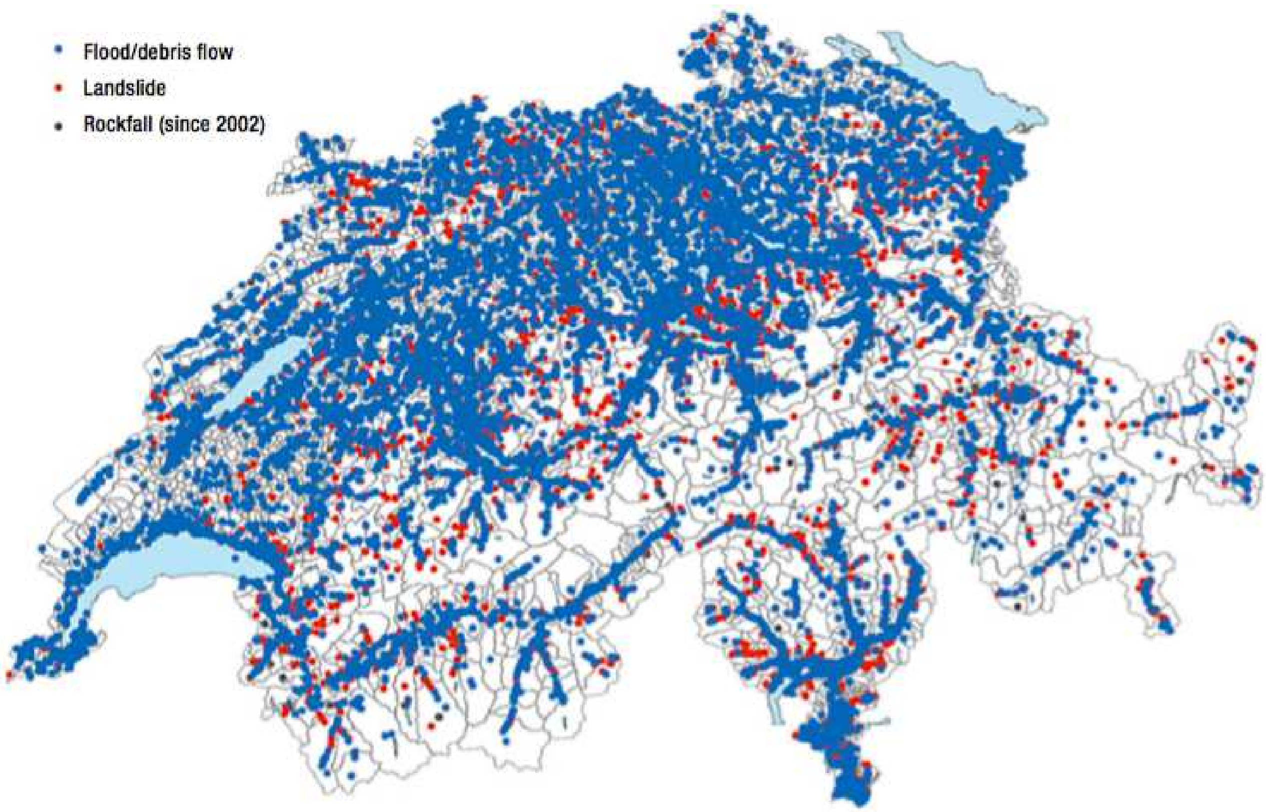


Figure 1.5: Natural hazards in Switzerland- each point on the map refers to a damaging event that arose in the period between 1972 and 2014 and was reported by Swiss media. Over 90 percent of the total damage was caused by floods and debris flows. The white areas are mostly located in the Alps and Jura region where there are few buildings and infrastructure that can be damaged (source WSL, from FOEN, 2015).

Where hazards do occur in Switzerland, they tend to be well managed and well monitored:

"It is impossible for us to imagine how Switzerland would look without natural hazard prevention. Large parts of the country located in the mountain region and river valleys would be uninhabitable due to lack of safety" Baumgartner (FOEN, 2015).

There is no denying that Switzerland's topography has generated a resourceful and risk-aware society, capable of protecting themselves with infrastructure and expertise. However, as noted earlier, a relative rarity of large-scale, country-wide disasters means integrated risk management might tend to have been more rigorously tested at the local and municipal scales, rather than at national or trans-boundary levels of cooperation.

Widespread flooding in August 2005 is perhaps the most notable recent event offering lessons to be learned and again in 2014, large storms produced heavy rain and flooding over a wide area of the Alps. The highly variable Swiss topography, its varied climate (ranging from Mediterranean in the south to temperate in the north, along with local alpine influences), and its trans-boundary setting, can offer valuable insights into creating comprehensive strategic approaches to mitigating risk when addressing variations of scale.

A specifically "Swiss aspect" of climate change science and adaptation is its Alpine setting (Brönnimann, 2014). He notes that the Alps make climate change impacts more apparent and for some aspects, (such as tourism, hydropower and extreme events) acutely relevant and perceivable (e.g. retreating glaciers).

Switzerland's alpine landscape is changing considerably with glacier retreat, and alongside this trend there is growing concern that its character and attractiveness to tourists may also possibly change. It is thought the glaciated regions of the Alps will have decreased by three-quarters by 2050, in comparison to the period of the late nineties (1971-1990 (OcCC, 2007). Figure 1.6 is taken from the OcCC 2007 report and shows projected impacts climate change might have in terms of temperature increase scenarios, on snow reliability in Swiss resorts. It is estimated that by the mid 21st Century, only 50-60% of Swiss ski regions will still be snow-reliable (OcCC, 2007). There are obvious economic implications of this trend for the ski industry, which will be explored further in Case Study A, but there are also significant social implications too, in terms of demand for winter sports, interest of younger generations in skiing, not least the changing aesthetics, accessibility and safety of ski resorts and mountainous areas.

Region	Number of skiing regions	Snow-reliability			
		today	+1°C[a)]	+2 °C[a)]	+4 °C[a)]
Vaud and Fribourg Alps	17	100%	65%	53%	6%
Bernese Oberland	26	96%	85%	62%	12%
Central Switzerland	20	90%	75%	55%	20%
Eastern Switzerland	12	83%	58%	58%	8%
Grisons	36	100%	97%	97%	83%
Valais	49	100%	100%	100%	80%
Ticino	4	100%	75%	50%	0%
Switzerland	164	97%	87%	79%	49%

a) time horizon: +1 °C: ca. 2020s; +2 °C: ca. 2050; +4 °C: towards the end of the century

Figure 1.6: Snow reliability in Swiss skiing regions under current and future climatic conditions. (Abegg *et al.* 2007, from OcCC report, 2007)

Management of glacier grottoes and similar tourist attractions is becoming increasingly difficult and expensive (OcCC, 2007). Temporary measures currently used to impede melting, such as covering the glaciers and ice fields with protective sheets in some locations will not be able to stop the retreat (Figure 1.7).

There is therefore a strong need, not just to improve and update adaptation strategies in order to keep up with a changing climate and cope with associated hazards, but to prioritise and balance delivery of the essential measures whilst managing public perceptions of the changing climate and associated hazards in reality. To keep an objective and holistic view of the changing environment and inevitable resultant socio-economic implications, but also to recognize that where there are negative impacts, there are also opportunities, such as expanding the Summer tourism sector. Chapter 2 goes on to signpost key policy, legal and scientific approaches in Swiss Climate Change Adaptation strategies and Disaster Risk Reduction.

Figure 1.7: The practice of covering glacier ice with tarpaulins does little to slow retreat (photos taken from Stubaier Gletscher, in the Austrian Tyrol region) December, 2016. L. Booth.

2. Swiss legal, policy and science approaches to CCA and DRR

Switzerland's legal mandate for adaptation to climate change is strongly anchored to its revised CO_2 Act and the CO_2 Ordinance which took effect on 1 January 2013. They form a multi-sectoral framework for Swiss climate policy for the period 2013 to 2020 (FOEN, 2014). Switzerland intends to reduce its domestic greenhouse gases by at least 20% in comparison to their 1990 level, by 2020. This Act also mandates the federal government to coordinate climate change adaptation activities.

In a de-centralised system like Switzerland, allocation of funds to the various levels of government is seen as an additional challenge, which can be exacerbated in times of fiscal conservatism (Prior *et al.* 2016). This can mean that certain austerity policies might potentially lead to a shift in responsibility, from institutions to the population itself (Prior *et al.* 2016). More detailed analysis of this system, operating in both theory and practice will follow in Chapter 4.

a) Key Players in CCA and DRR in Switzerland

The following are the key organisations involved in CCA and DRR in Switzerland. For descriptive information of each, the 2017 OECD report can be referred to, or individual websites visited for latest projects.

- **Federal Office for the Environment (FOEN):** FOEN is responsible for water-related disasters such as floods and debris flows, landslides, rock fall and avalanches. Storms and forest fires as well as coordination of the federal earthquake mitigation program also fall under FOEN's responsibility. https://www.bafu.admin.ch/bafu/en/home.html
- **Federal Office for Civil Protection (FOCP):** responsible for protection of the population in cases of catastrophes and emergencies. FOCP is responsible for risks that are of national importance (such as increased radioactivity, satellite crashes, dam bursts, epidemics and armed conflicts). It is also responsible for national risk analysis for disasters and emergencies in Switzerland. http://www.babs.admin.ch/en/home.html
- **Federal Office for Spatial Development (ARE):** plays a key role in providing national guidance for a hazard-informed spatial planning approach and determining fundamental rules https://www.are.admin.ch/are/en/home.html
- **Federal Office of Meteorology and Climatology (MeteoSwiss):** Climate-related and meteorological hazards, such as heatwaves or cold snaps lie in the responsibility of the Federal Office of Meteorology and Climatology. http://www.meteoswiss.admin.ch/home.html?tab=overview
- **Swiss Federal Institute for Forest, Snow and Landscape Research (WSL):** http://www.wsl.ch/index_EN
- **Federal Roads Office (FEDRO):** Plays an important role in guaranteeing roads and motorways remain functional or become functional again during and after disasters. https://www.astra.admin.ch/astra/en/home.html
- **Swiss Seismological Service (SED, Erdbebendienst):** Federal agency responsible for monitoring earthquakes in Switzerland and its neighbouring countries and for assessing Switzerland's seismic hazard. http://www.seismo.ethz.ch/en/home/
- **Institute for Snow and Avalanche Research (SLF)**: assesses avalanche danger in the Swiss Alps and issues daily avalanche bulletins in the winter. http://www.slf.ch/index_EN
- **Bundesstab ABCN:** Switzerland's National Crisis Coordination Committee- identifies practical solutions for high impact, complex incidents. https://www.naz.ch/de/naz/eo.html
- **National Environment Agency (BAFU):** https://www.bafu.admin.ch/bafu/de/home.html
- **Insurance companies (both public and private)** https://www.schutz-vor-naturgefahren.ch/

Figure 2.1 groups the key actors into sectors and lists key roles.

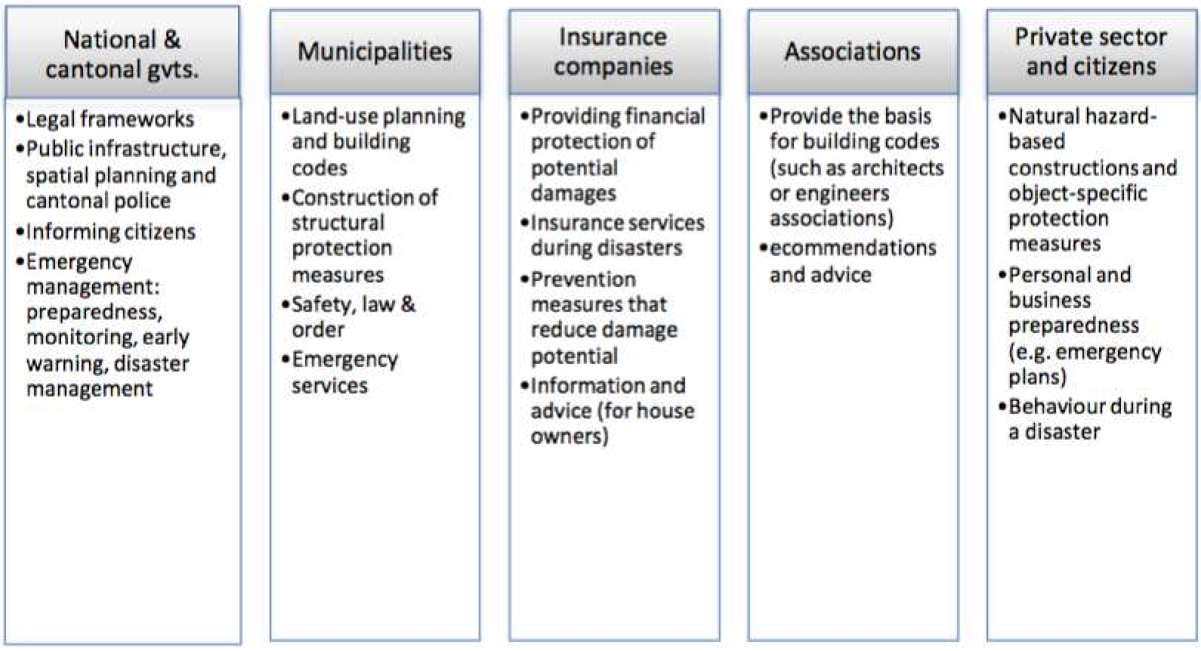


Figure 2.1: Actors responsible for natural hazard management in Switzerland (OECD, 2017).

National coordinating bodies include **PLANAT** http://www.planat.ch/ and **LAINAT***:* The Steering Committee Intervention in Natural Hazards (LAINAT), founded in 2008, brings together all federal agencies (FOEN, FOCP, MeteoSuisse, WSL/SLF, ETHZ/SED) in charge of forecasting and warning about natural disasters together. LAINAT is in charge of informing and preparing for major disasters.

The National Platform for Natural Hazards (PLANAT) comprises 18 members including Federal and Cantonal agencies, transport sector, private sector, research institutions and insurance companies. They have established a strategy for "Protection against Natural Hazards" in 2004/5. They are at present, in the process of updating this strategy and associated actions (personal communication). They identify 7 key steps in trying to optimize protection against natural hazards:

1) Protection goals are determined for life and limb and belongings
2) Preventative measures, response and recovery mechanisms are equally considered to manage prevailing risks. The necessary legal, procedural, economic and personnel conditions have to be provided in order to guarantee this quality.
3) Periodic investigation about development of hazards and risk and about vulnerability changes of systems are performed. Additionally, the effectiveness and efficiency of implemented measures are regularly evaluated.
4) Management of residual risk is evaluated from a legal point of view.
5) Natural conditions are included in protection concepts. Wherever possible, adequate space is provided for natural processes.
6) The necessary research for improvement of hazard management is implemented and practical education is improved.
7) The international collaboration in the field of disaster management is strengthened.

b) Swiss trans-boundary and international collaboration

Switzerland is a member of the Alpine Convention, an international treaty between eight Alpine countries

(Austria, France, Germany, Italy, Liechtenstein, Monaco, Slovenia and Switzerland) and the European Union. The treaty sets out to ensure protection of the Alps and stresses the high value of sustainable development of the Alpine region (OECD, 2017). Since 2004, the Alpine Convention includes the Natural Hazards Platform of the Alpine Convention (PLANALP) that contributes to the development of joint approaches to risk reduction and is mandated to implement subsequent measures, including flood (risk) management plans.

Switzerland is engaged in PLANALP through PLANAT. Switzerland is also a member of several transboundary river commissions, such as the International Commission for the Protection of the Rhine (ICPR), that elaborate basin-level flood risk management plans. Switzerland is currently engaged in a cross border dialogue on the management of the Rhône that may develop into the creation of a coordinating body administered together with France (see Case Study B).

At an international level, Switzerland cooperates with UNISDR, particularly in regard to implementing overarching international frameworks. PLANAT has a small working group on international affairs and a number of federal offices, including FOEN, maintain collaborations with neighbouring and overseas countries. Moreover, scientific institutions e.g. ETH Zurich foster collaboration with other global research institutions (OECD, 2017).

2.1 Legal, policy and science approaches in Disaster Risk Reduction

Protection of the population and important assets against natural hazards is provided as a public service by the state. In the federal state of Switzerland, this task is perceived as the joint task of the Confederation, cantons and municipalities. The authorities on all three levels work closely with each other in this area, which requires close cooperation. Thus, for example, the 26 cantons are responsible for the maintenance and protection of forests and water bodies, hazard mapping and the planning, construction and maintenance of protective structures – however they receive financial and expert support from the federal authorities (FOEN, 2015).

The Federal Office for the Environment (FOEN) is responsible for the strategic management of these tasks and guarantees safety at the national level upholding a basis of uniform standards. It is up to the 26 cantons to decide whether to organise these tasks centrally or to delegate some of them to the political municipalities, of which there are 2,324 (status: 1.1.2015) in Switzerland. Thus, the system accommodates the cultures of political cohabitation which vary from region to region. Case Study B explores this system further.

"The prosperity enjoyed by the Swiss population is also due to the significant progress achieved in providing safety against natural hazards through the joint efforts of various federal authorities, the cantons, communes and individuals" **(Josef Hess, Vice Director, FOEN, 2015).**

The Climate Action Plan of Switzerland 2014-2019 identifies 63 actions across a multi-stakeholder involvement method, including government, NGOs, business groups, academia and others. Of 26 Cantons, 10 have produced cantonal adaptation strategies/ plans: Cantons Basel-Stadt, Schaffhausen, Bern, Uri, Graubuenden, Aargau, Appenzell-Innerrhoden, Appenzell-Ausserrhoden, St Gallen, Thurgau and Zurich. These are available online.

One measure successfully implemented in Switzerland to assist with limitations of scale, is creation of hazard maps, now available in all areas of Switzerland. The Swiss Government subsidized all its cantons with money and relevant knowledge to complete hazard maps for every municipality by 2011. These were to be used as a fundamental basis for regional land use planning, hazard prevention, developing national concepts, construction planning outwith endangered areas and for the granting of subsidies (Kunz, 2008).

Development of the *AlertSwiss* website and mobile phone application (https://alertswiss.ch/), led by the Federal Office for Civil Protection (FOCP) aims at increasing preparedness of the Swiss population, which aligns recent Swiss advances in enabling disaster communication with the population, with recommended international approaches (Prior *et al.* 2016). The FOCP is the leading Federal Office in Switzerland for integrated risk management, which coordinates actions during disasters with other federal offices, cantons and municipalities (Section 2.a).

Scientific Approaches in relation to DRR- Swiss Earthquakes

Mapping of Switzerland's earthquake hazard (Figure 2.2) has been published in a 2004 report, "Seismic Hazard Assessment of Switzerland". The work was supported by ETH Zurich, the Swiss Nuclear Safety Board (HSK), the Swiss National Foundation (SNF), Swissnuclear and by re-insurance and insurance broker companies (SwissRe, MunichRe). This reflects a collective and supportive approach to scientific advancements in Disaster Risk Reduction in Switzerland.

In 1998, Grünthal *et al*. (1998) provided a harmonized seismic hazard assessment between Germany, Austria and Switzerland (D-ACH). The D-A-CH map was used as input for the Global Seismic Hazard Assessment Program (GSHAP; Giardini *et.al.,* 1999). A new earthquake catalog for Switzerland was then published in 2003 (Fäh *et al.,* 2003; Braunmiller *et al.,* 2004).

Research is underway in reconstructing and understanding past disasters, like major earthquakes, e.g. in Basel 1356 (SED, 2004). Information collected on past events is key to planning for future ones, yet direct extrapolations is not always possible due to major socio-economic changes. A comparable earthquake of the Basel region quake in 1356 would result in losses CHF 50 to CHF 100 billion today for example (SED, 2016).

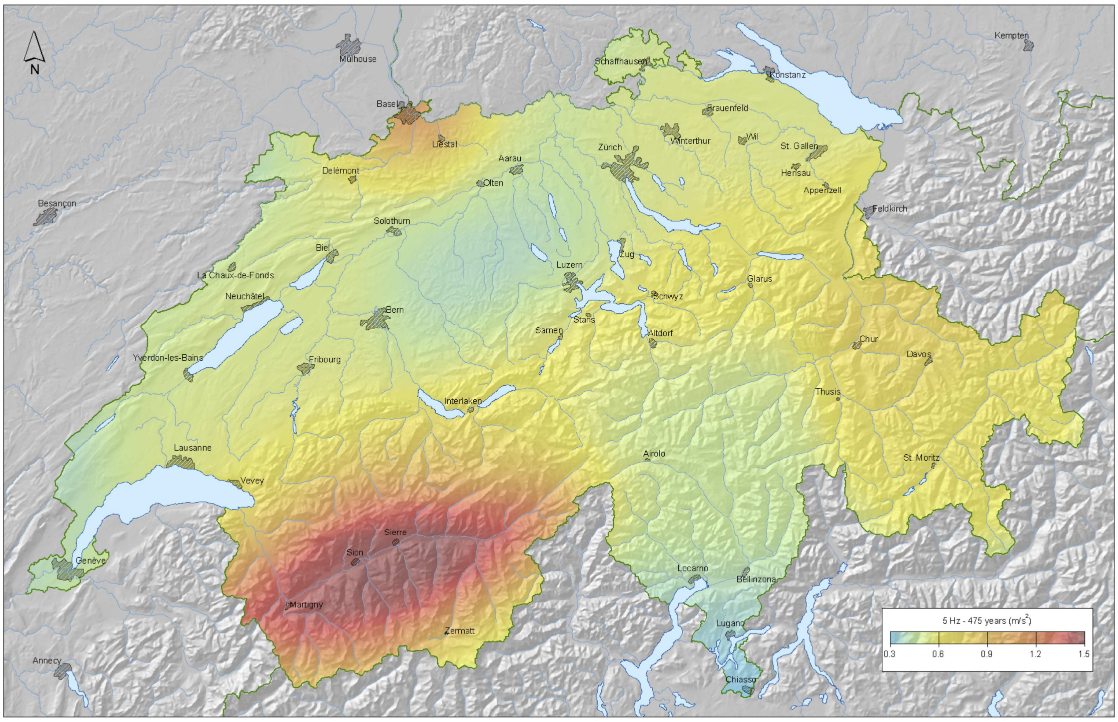


Figure 2.2: Seismic hazard map of Switzerland, depicting the level of horizontal ground-motion expected to be reached or exceeded in a period of 475 years (SED, 2004). Full report available at: http://www.seismo.ethz.ch

2.1 Legal, policy and science approaches in Climate Change Adaptation

Milestones 2009–2013

Year	Climate policy	Climate research	Development of the climate
2008	The first commitment period of the Kyoto Protocol (2008–2012) begins The CO_2 levy on thermal fuels (12 fr. per tonne CO_2; 3 ct. per litre of heating oil) is introduced Emissions trading begins in Switzerland	The Centre for Climate Systems Modeling C2SM (ETH Zurich) is founded	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 385.3 ppm
2009		The FOEN and WSL launch the research programme "Forestry and Climate Change" Third World Climate Conference in Geneva: The "Global Framework for Climate Services" is established	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 386.7 ppm 2009: Globally the sixth warmest year since measurement began; in Switzerland, the seventh warmest year
2010	The Confederation and the cantons launch the buildings programme The CO_2 levy on thermal fuels rises to 36 fr. per tonne CO_2 (9.5 ct. per litre of heating oil) UN Climate Conference in Cancún (Mexico): Limiting global warming to 2 degrees is recognized as target	The National Research Programme "Sustainable Water Management" (NRP 61) is launched	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 388.2 ppm 2010: Globally the warmest year since measurement began
2011	Negotiations for linking Swiss-EU Emissions Trading Schemes are initiated	Swiss Climate Change Scenarios CH2011 are published The first risk analyses on the impact of climate at a regional level are started	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 391.0 ppm 2011: the warmest year in Switzerland since measurement began
2012	The Federal Council adopts the first part of the strategy "Adaptation to climate change" UN Climate Conference in Doha: A group of countries incl. Switzerland commit to continue the Kyoto Protocol until 2020 The first commitment period of the Kyoto Protocol ends	The project "Climate Change and Hydrology in Switzerland" is established	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 392.9 ppm
2013	The revised CO_2 Act and CO_2 Ordinance enter into force: new reduction target –20 % by 2020 The Confederation invites bids for pilot projects for adaptation to climate change	The National Centre of Competence in Research Climate (NCCR Climate) concludes its activities Part I of the IPCC's Fifth Assessment Report is adopted: "Human influence on the climate system is clear."	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 395.3 ppm 2013: Globally the sixth warmest year since measurement began
2014	The CO_2 levy on thermal fuels is increased to 60 fr. per tonne CO_2 (16 ct. per litre of heating oil) The Federal Council adopts the second part of the strategy "Adaptation to climate change"		The CO_2 concentration in the atmosphere (Mauna Loa) reaches 397.5 ppm

Figure 2.3: Milestones in Swiss policy towards Climate Change Adaptation 2008-2014 (FOEN, 2014).

Scientific Approaches in relation to Climate Change Adaptation in Switzerland

Switzerland's institutions are proactive in understanding climate change more precisely, trying to better quantify and map expected changes; identifying measures for mitigation, adaptation and for disaster risk reduction at a global and national level. The National Centre of Competence in Research Climate (NCCR Climate) focusses on studying climate progression and its impacts, from 2001 to 2013. Its comprehensive work programme acted as a stimulus for extending climate research in Switzerland. In 2007 the Oeschger Centre for Climate Change Research at the University of Bern was created, followed by the Centre for Climate Systems Modelling (C2SM), based at ETH Zurich in 2008 (FOEN, 2015).

C2SM published revised climate scenarios for Switzerland in 2011 which more accurately estimate effects of climate change on Swiss sectors and society. These new scenarios forecast that by the end of the 21st Century, if worldwide greenhouse gases are not significantly reduced successfully, temperatures will rise by another 2.7 to 4.8°C above the average in the years 1980-2009. They also identify that even if global greenhouse gas emissions are successfully halved by 2050, compared with 2000 levels, a further temperature rise of 1.2 to 1.8 °C is expected in Switzerland by the turn of the century. As a result, the zero-degree level and the snow line in Switzerland are thought likely to increase by several hundred meters. Indeed, the zero-degree level is now around 350m higher than it was 50 years ago (FOEN, 2015).

Figure 2.4 gives an overview of Swiss science programs since the 1990s (Brönnimann et al. 2014).

MAIN NATIONAL CLIMATE RESEARCH PROGRAMS FUNDED BY THE SWISS NATIONAL SCIENCE FOUNDATION

National Research Project NRP31 'Climatic Changes and Natural Hazards' (1992–1997)

Swiss Environmental Priority Programme, specifically subproject 'Climate and Environment in the Alpine Region' CLEAR (1997–2000)

National Competence Centre for Research (NCCR) in Climate (2001–2013)

INITIATIVES OF THE SWISS SCIENTIFIC COMMUNITY

Climate Change and Switzerland 2050—Impacts on Environment, Society, and Economy (CH2050)[4] (2007)

Swiss Climate Change Scenarios—CH2011[5] (2011)

Toward Quantitative Scenarios of Climate Change Impacts in Switzerland —CH2014-Impacts[6] (2014)

Figure 2.4 Swiss climate change research programmes (Brönnimann et al. 2014)

Agroscope	Research Institute of the Federal Office for Agriculture
C2SM	Centre for Climate Systems Modelling
EAWAG	Swiss Federal Institute of Aquatic Science and Technology
EMPA	Swiss Federal Laboratory for Materials Testing and Research
FOEN	Federal Office of the Environment
MeteoSwiss	Federal Office for Meteorology and Climatology
OcCC	Organe consultatif sur les Changements Climatique (Advisory Body on Climate Change for the Swiss Government)
OCCR	Oeschger Centre for Climate Change Research
ProClim	Forum for Climate and Global Change of the Swiss Academy of Sciences
PSI	Paul Scherrer Institute
SNSF	Swiss National Science Foundation
WSL	Swiss Federal Institute for Forest, Snow and Landscape Research

Figure 2.5 Table showing Swiss research institutions coordinating work on CCA projects (Brönnimann et al. 2014)

Risk Assessment in Switzerland

Risk assessment in Switzerland is improving rapidly and is exemplary in its coverage of the Cantons. Online portals and tools referenced in this document show increasing accessibility to risk assessment data via websites such as:

http://map.geo.gr.ch/naturgefahrenkarte/naturgefahrenkarte.phtml

http://www.natural-hazards.ch/home/current-natural-hazards.html

Integration of hazard maps into land-use plans and land-use decisions has been high priority in Switzerland. The spatial planning law obliges cantons to identify areas that are potentially threatened by natural hazards. The hazard-informed land-use plan, constitutes a mandatory regulatory instrument. When considering gaps in the availability of flood maps (Figure 2.6), these maps presented by BAFU, to OECD in 2016, reflect just how far Switzerland has come in terms of hazard and risk assessment in the last ten years.

Prediction and forecasting improvements support the updating of hazard maps and coverage of unfolding hazard events via the media all lend freely accessible information in preparation for mitigating risk. Refinement of aspects of risk assessment will be supported by new technology, such as 3D Visualisation. Switzerland appears at the forefront of using technology to support its policy development.

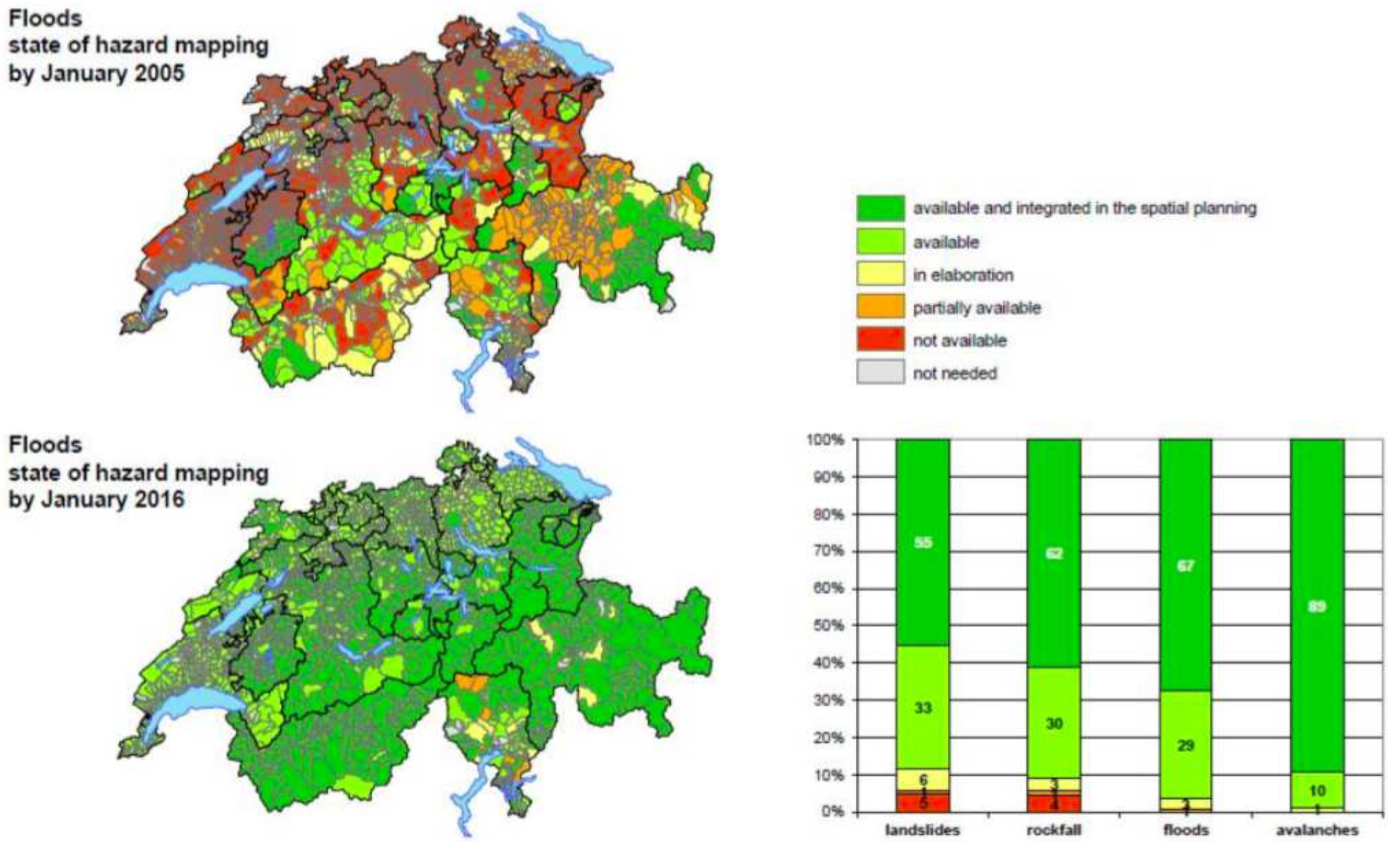


Figure 2.6 Hazard mapping between the years 2005 and 2016 (BAFU, 2016, courtesy of OECD 2017).

2.3 Legal/policy and science approaches combining CCA & DRR

The intersection or overlap between Disaster Risk Reduction (Figure 2.7) and Climate Change Adaptation (Figure 2.8) is an area for opportunity and growth in Switzerland, as in other countries. Figure 2.9 distinguishes the components of both disciplines and compares their challenges.

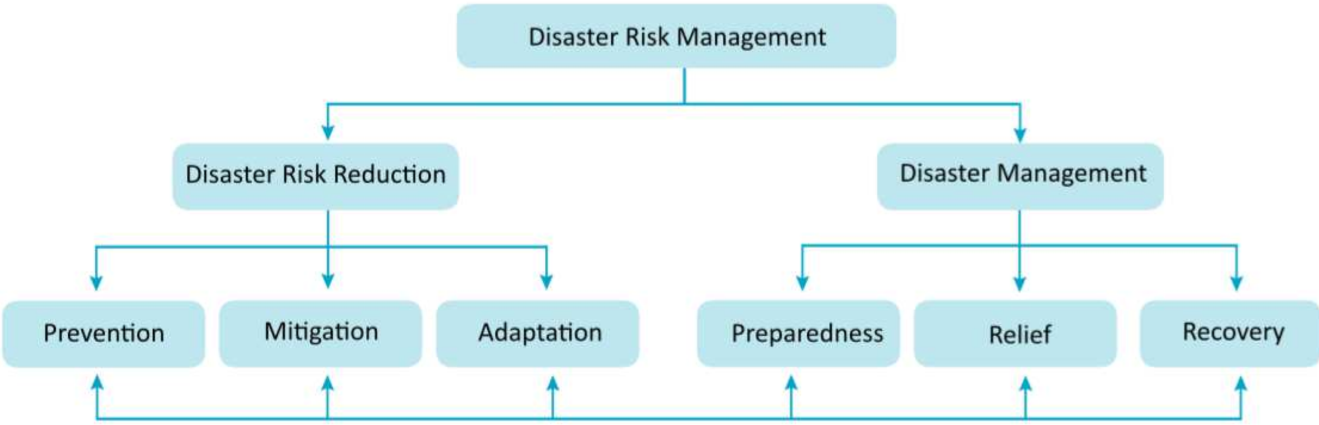


Figure 2.7: Disaster Risk Reduction and its components, UNISDR, 2012.

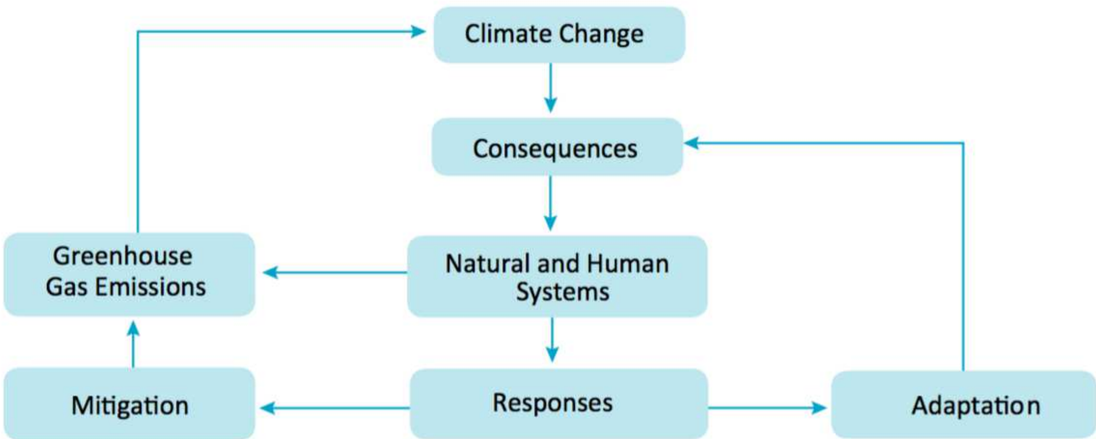


Figure 2.8: Climate Change Adaptation, UNISDR, 2012

Figure 2.9 (modified from Venton and La Trobe, 2008) identifies the intersection as reducing vulnerability and increasing resilience (UNISDR, 2012). In practical terms, the same infrastructure put in place to channel a flood away from a house caused by meterological/ climatic drivers such as heavy downpour, can also channel a flood away from the same house after a dam burst in an earthquake. Whether the cause is meteorological or geophysical, Switzerland's alpine area holds countless examples of infrastructure aimed at making a population more resilient, both from more gradual climatic shifts, and indeed from sudden disasters which occur with little or no warning.

The lowlands however, is a different arena. Here, growing populations are taking up more space, using more resources and will increasingly benefit from finding joint approaches between CCA and DRR. All sectors have an invested interest in both spheres (Water supply, agriculture etc.) In particular, Swiss insurance companies recognize the links between CCA and DRR in Switzerland and they already act as a key sector helping to synergise the 2 disciplines (Case Study B).

Figure 2.9: Synergies between CCA and DRR (UNISDR, 2012)

Figure 2.10 by contrast, explores some key differences between Climate Change Adaptation measures and Disaster Risk Reduction approaches (Venton & La Trobe, 2008) and makes reference to signs of convergence, some of which can be seen in Switzerland, particularly regarding integration of scientific knowledge and climate change adaptation specialists being recruited from a multi-sectoral base (red arrows). However, there are always challenges in maintaining effective processes in transitional zones, e.g. trans-border, that often have very specific intricacies, known only to the operators that live and work there.

While Federal law and international strategies might provide a theoretical mechanism for synergy, in practice, often at the operational level, this might come with a very different and specific set of challenges unique to each area. The Case Studies in Chapter 4 will explore this in more detail. It is often the local arena that provides generation of new ideas, examples of best practice and innovative solutions which might then be transposed as a template to assist other regions. Therefore, there is a spatial component to Figures 2.9 and 2.10 that ought to be kept in mind.

Sometimes it is the other way around and where synergies might be obvious at a local level, there might be low political will to integrate DRR and CCA (e.g. Gero et al., 2011b; UNISDR, 2010, 2012). Dupuis (2011) highlights that irrespective of developed or developing countries, low political interest to integrate will remain a key challenge moving forward. There is weak political recognition for DRR when compared to CCA in some countries (Mitchell & van Aalst, 2008; Venton & Trobe, 2008) although this is not necessarily the case in Switzerland. In order to create an enabling environment to integrate CCA and DRR, political commitment should be increased by the high-level political authorities (UNISDR, 2010).

In summary, integration of CCA and DRR is very much a two-way process, requiring cooperation from the top-down, and from the bottom, up. In Chapter 4, perspectives from both ends of this spectrum are taken into account in Case Studies A and B, plus a researcher’s view of the complexities at a trans-boundary setting in Case Study C.

DIFFERENCES		SIGNS OF CONVERGENCE
DRR	**Climate change adaptation**	
Relevant to all hazard types	Relevant to climate-related hazards	n/a
Origin and culture in humanitarian assistance following a disaster event	Origin and culture in scientific theory	Climate change adaptation specialists now being recruited from engineering, watsan, agriculture, health and DRR sectors
Most concerned with the present – i.e. addressing existing risks	Most concerned with the future – i.e. addressing uncertainty/new risks	DRR increasingly forward-looking Existing climate variability is an entry point for climate change adaptation
Historical perspective	Future perspective	As above
Traditional/indigenous knowledge at community level is a basis for resilience	Traditional/indigenous knowledge at community level may be insufficient for resilience against types and scales of risk yet to be experienced	Examples where integration of scientific knowledge and traditional knowledge for DRR provides learning opportunities [36]
Structural measures designed for safety levels modelled on current and historical evidence[37]	Structural measures designed for safety levels modelled on current and historical evidence and predicted changes	DRR increasingly forward-looking
Traditional focus on vulnerability reduction	Traditional focus on physical exposure	n/a
Community-based process stemming from experience	Community-based process stemming from policy agenda	n/a
Practical application at local level	Theoretical application at local level	Climate change adaptation gaining experience through practical local application
Full range of established and developing tools [38]	Limited range of tools under development	None, except increasing recognition that more adaptation tools are needed
Incremental development	New and emerging agenda	n/a
Political and widespread recognition often quite weak	Political and widespread recognition increasingly strong	None, except that climate-related disaster events are now more likely to be analysed and debated with reference to climate change [39]
Funding streams ad hoc and insufficient	Funding streams sizeable and increasing	DRR community engaging in climate change adaptation funding mechanisms

Figure 2.10. Similarities and differences between CCA and DRR (Venton and La Trobe, 2008). Red arrows relate these signs of convergence to Swiss-specific cases, explained further in Chapter 4.

3. Research methodology

This report is part of a wider synthesis within the framework set by the ESPREssO Project to collect data across six European countries (UK, Switzerland, Italy, France, Germany and Denmark) which will each produce reports on their specific national approaches regarding policy, legislation and science frameworks which are actively addressing natural hazards and climate change adaptation. These national reports will then feed upwards into a synthesis of such approaches at a European level and globally.

In order to guarantee a comprehensive approach to allow consolidation of data from the national reports, a conceptual framework (Figure 3.1) was developed based on a literature review regarding the project's three main challenges:

1. To propose ways to create more coherent national and European approaches on Disaster Risk Reduction, Climate Change Adaptation and resilience strengthening;
2. To enhance risk management capabilities by bridging the gap between science and legal/policy issues at local and national levels in six European countries;
3. To address the issue of efficient management of transboundary crises.

Data collection instruments used to satisfy the criteria for this review include: building a literature review, carrying out semi-structured interviews for primary data analysis and assessing federal/ research organisation reports which review the Swiss system. The intention is to combine and compare our own findings with the existing literature but to link this strongly to the key themes of ESPREssO.

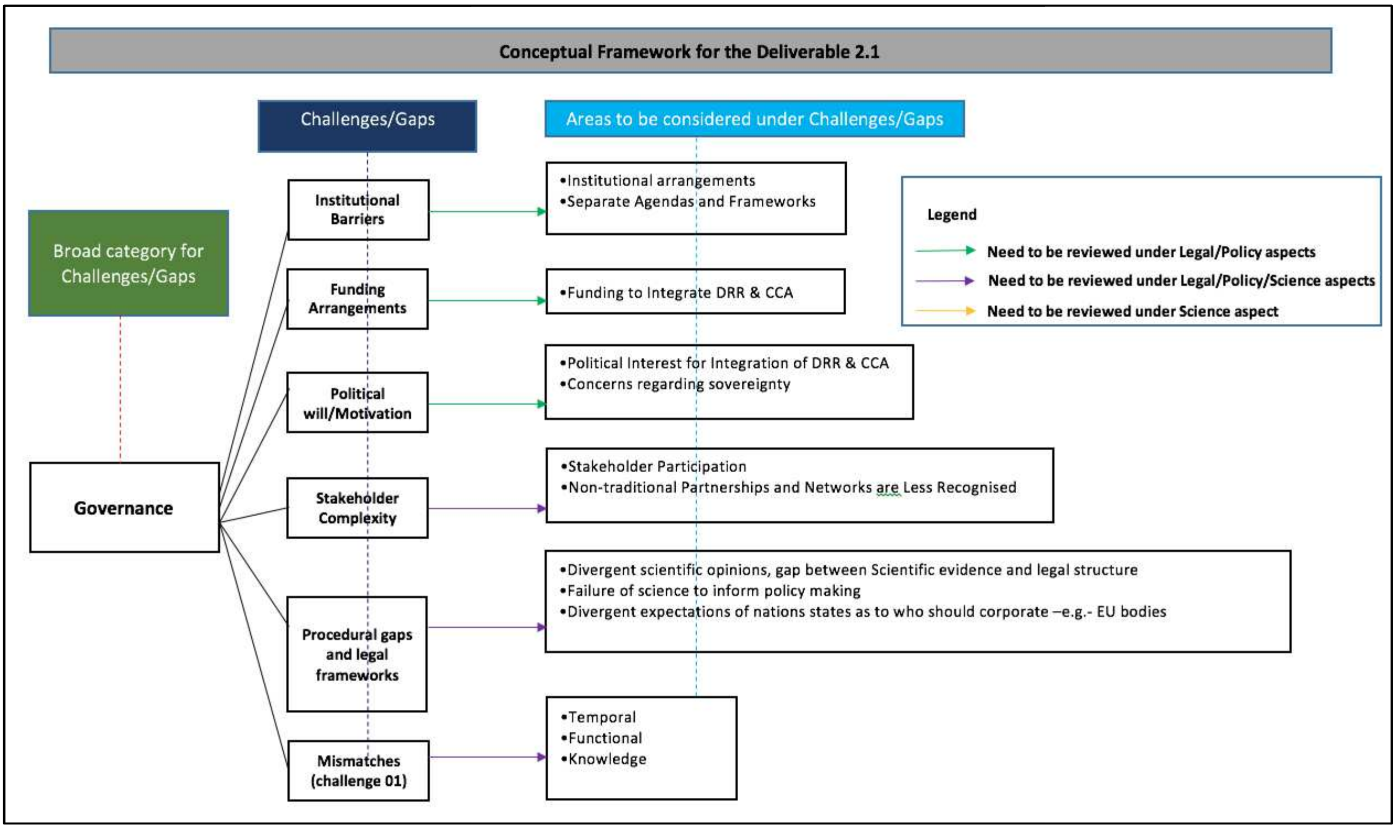
Interviews were therefore carefully selected with experts from both practitioner and policy-making levels within CCA and DRR, which would help illustrate some of the Swiss issues mentioned in the previous Chapters in more detail. Experts were also chosen in order to represent both the CCA and DRR communities at different governance levels (such as both Federal and local level) and from different disciplines, (some interviewees had an engineering background, others tourism, for example).

In addition to the framework, a guideline for semi-structured interviews was prepared that was to be used for all national reports with the possibility to modify questions according to the national context. While interviews were conducted on the basis of the template therefore, it was kept mainly as a guide and allowed discussions to include other relevant aspects as appropriate. For data analysis, we used qualitative methods in synthesising information, such as interview recordings and note-taking based on the themes of the conceptual framework.

We have also chosen to follow up some of our interviews with field visits (ie. Toggenburg ski resort, City of Zurich and Geneva) to see adaptation measures in situ. We deemed this appropriate in capturing the local context.

We conducted desk-based studies into key Swiss policy documents- the qualitative analysis is based on thorough review of existing scientific literature, agency reports, technical reports, advanced reviews and websites as well as legislative texts.

The framework overleaf (Figure 3.1) identifies key areas for determining potential issues and gaps within the three mentioned challenges. The identified categories were governance, risk, scientific frameworks and communication. Within each category, potential gaps and challenges were proposed to guide data collection and analysis. Chapter 4 goes on to break down the issues and highlight where currently in Switzerland there are both opportunities and gaps in addressing the 3 challenges.



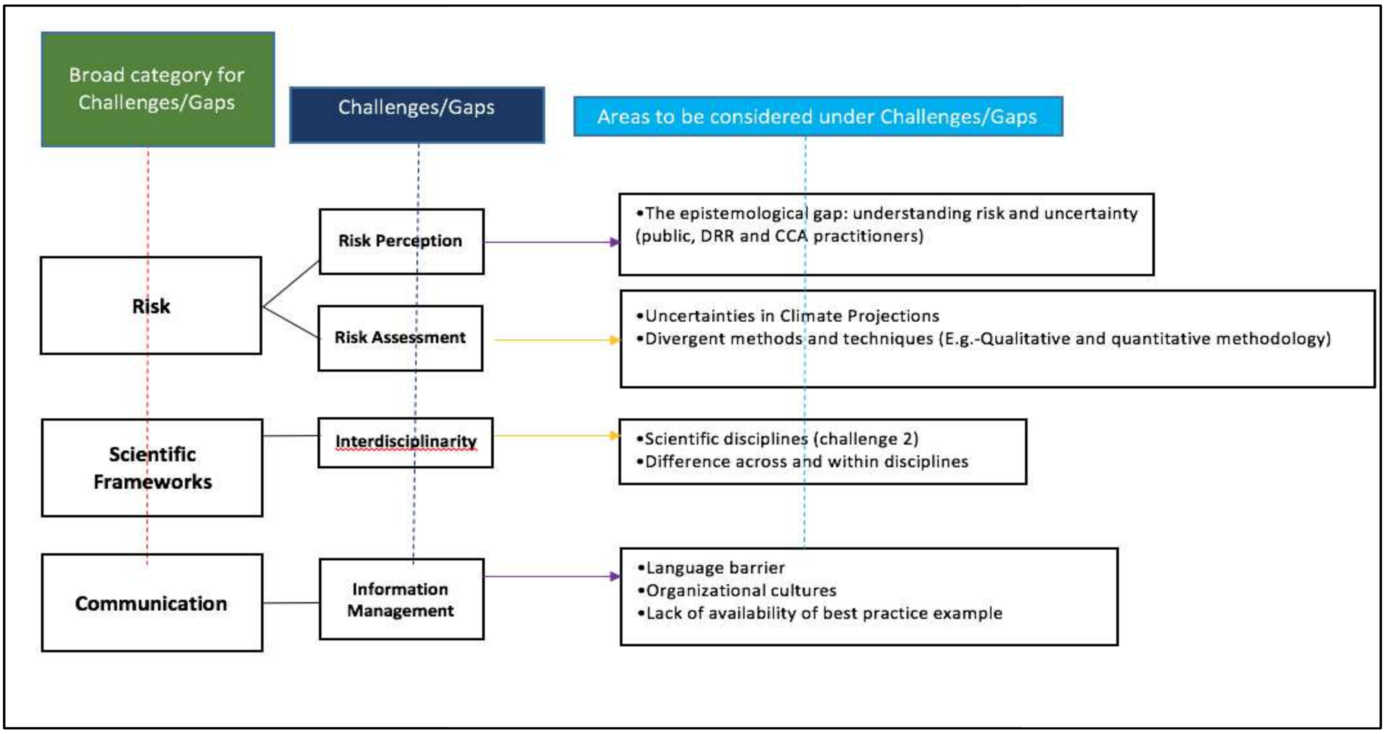


Figure 3.1 Conceptual Framework, Work package 2, ESPREssO

4. Analysis and findings

This section reviews the existing legal, policy and science approaches to CCA and DRR in Switzerland (outlined in Chapter 2), but explores further the key challenges and gaps as well as opportunities. The analyses and findings are anchored around 3 case studies, excerpts from which are interspersed throughout the text. Information was also drawn from a literature synthesis, personal communication and interviews. The first case study addresses perhaps one of the most emotive aspects of Climate Change in Switzerland- adapting to declining snow reliability.

Case Study A: Decreasing snow reliability's effect on the Swiss tourism sector.

Climate Change Adaptation- Perspectives from a Swiss practitioner, a local, private-sector ski resort company Melanie Eppenberger, Toggenburg Bergbahnen (TB), Wildhaus- Alt St. Johann. Interview Dec 2016.

Locality description and Introduction

Toggenburg ski resort, in Wildhaus-Alt St. Johann, accessible from Zurich (1hr) is historically famous for skiing and hiking. Chäserrugg Mountain (2262 m), is an unusually flat-topped alpine mountain forms the Toggenburg ski resort's highlight and the company's focal point for planning/ investment.

Toggenburg Bergbahnen's priority is to "*maintain a natural experience at the resort for all" (Eppenberger, 2016, interview)* meaning minimal advertising in the cable car stations. The company has decided to invest in expanding both their winter and summer tourism, rather than relying on a shortening Winter ski season. Every future investment they will make, is now with the aim of being profitable in both summer and winter. This will hopefully have positive knock-on effects for the surrounding valley businesses. Awareness is also kept in mind for how it might be run for the next generation:

"I think probably for us, for my Husband and for me, the fact that we have also children, we begin to think differently, to be aware of what we have and what they maybe won't have in 50 years from now" (M. Eppenberger, Toggenburg Bergbahnen, 2016 interview).

Toggenburg Bergbahnen, as a private company, have taken Climate Change Adaptation into account in developing their business strategy, having observed that skier days are decreasing. They have tried to stabilise this trend, and address the problem, by making the resort accessible and attractive to visitors all year round. They recognize they have a beautiful attraction in Chäserrugg mountain, so they have worked hard to expand its appeal to non-skiing visitors as well, all year, thereby preventing "gaps" in income in the non-skiing season.

Recently, Toggenburg Bergbahnen needed to replace some older resort infrastructure (cable cars) for new equipment, so a new strategy for the resort was developed and implemented over 4 years. Before investment measures were taken, the company had 28 % of their turnover in summer. Their goal was to improve that figure while maintaining winter income levels. The scheme has been a success thus far with successful 2014/15 and 2015/16 seasons. 2017 has also started well.

Issues: Climate Risks

On average over the last 20 years, there have been 120 days winter season (snow days). However, less winter precipitation and rising temperatures are causing issues for Swiss ski resorts (Chapter 1) and posing challenges for cable car companies, who need increasingly to squeeze more revenue from a shortening ski season (Figure 4.1) and a rising snow line, or diversify. This trend could have significant long term impacts on the Swiss tourism sector.

If less snow falls in Spring (March), less melt affects the water balance later in the season. By end of summer (even up to Nov/Dec), before first snows arrive, there is more increasingly a risk of drought/ forest fires (also seen across the border in Innsbruck, Austria in 2015 and 2016, where risks associated with New Year firework displays potentially sparking fires, limited where some displays were allowed to take place).

Increased storminess, particularly wind disturbance can affect resort equipment and visitor safety. Also, potentially increased risk of avalanche follows an unstable snow-pack creation, due to intermittent snowfalls and too-high temperatures which prevent a solid frozen base developing in the early season.

"I am deeply convinced, we would manage to fight against nature, but we won't win. It is not possible; and then, of course, costs on top of that. I would say that our basis was long-term thinking" (M. Eppenberger, Toggenburg Bergbahnen, interview 2016).

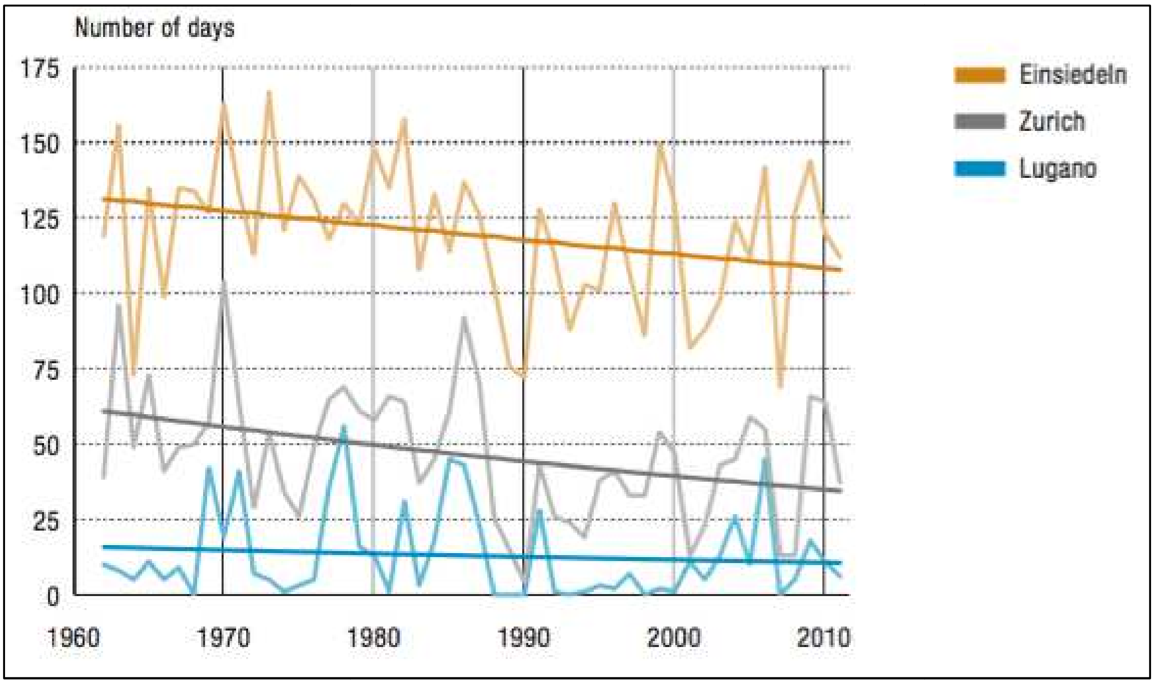


Figure 4.1: Snow days recorded between the years 1960-2010 in Switzerland (courtesy of MeteoSwiss 2012b). A general downward trend can be seen, prompting actions by the Swiss ski sector.

Sectoral Perceptions

Toggenburg Bergbahnen recognize they have to *"wait for the snow" (Eppenberger, 2016, interview).* They recognize that longer term it is unsustainable to challenge nature. This is an important attitude as many other localities do not recognize this and become increasingly reliant on technical snow to fill gaps in runs.

TB regard widespread use of technical snow as impossible to make profitable long-term. These machines need a water source and an electricity supply which isn't always possible at elevation (or it is costly to install). It would have cost Toggenburg Bergbahnen around 20 million CHF to implement this at Chäserrugg and was therefore rejected as an unaffordable measure. Artificial snow in resorts also means ski-tourers can only go on piste which reduces their enjoyment and leads to crowding on runs.

This opinion however does not go unchallenged. Local hotels for example often support installation of machines, in support of their business. Yet in terms of investment, they might only be willing or able, to contribute minimal investment to their purchase and upkeep.

10 million CHF worth of snow machines are however planned for an adjacent, lower-elevation resort at Wildhaus Bergbahnen AG. Some stakeholders at both the cantonal-level and even federal-level regard snow machines as a climate change adaptation measure. This, for Toggenburg Bergbahnen, is maintained as unsustainable over a period of time. Therefore different measures taken in near- adjacent ski resorts will yield two quite different long-term results.

A discrepancy is perhaps emerging between perceived versus actual Climate Change. It's not only about what is happening to our climate, it's what people think is happening with our climate. TB report encountering ski clients who expect good quality snow and won't accept partial closures (see Section 4.2.1) The changing ski "client" is also increasingly less prepared to adapt to hazards such as fog or wind.

The ski sector itself advertises possibilities to ski from November, yet Christmas has been green for many years (remembered by older generations). This sometimes creates unrealistic expectations among ski clients, especially foreign visitors. (Sample article): http://www.thelocal.ch/20170106/lack-of-snow-puts-visitors-off-swiss-ski-resorts

Measures put in place by Toggenburg Bergbahnen to cope with a changing climate

- They have built a flexible building on top of Chäserrugg, highly adaptable as restaurant, venue for concerts, seminars, parties and fully operable in both summer and winter seasons.
- Updated facilities are made more robust to hazards, e.g. enclosed cabin cable car lifts, instead of more exposed open chairs to minimise risk from high wind.
- If the ski season is delayed, there is a staffing contingency plan- Flexible staff are sourced from the local population who hold a close relationship to nature, i.e. they expect to work when it snows.
- Efficient heating by situating buildings together- Berg Gasthaus restaurant lies close to cable-car engine house.
- Avalanche protection exists (fencing) but there are no plans for more because there is an aesthetic element to consider in summer.
- Experts evaluate each day whether slopes are secure, or will trigger avalanche with bombs, hired by TB. Changing costs associated with this service in an uncertain climate.
- Hotel pressure is often in favour of producing mechanical snow. TB does not have much pressure from hotels so they have found it easier to reject the reliance on snow machines than in other resorts.
- Less emphasis placed at TB on expanding other sports (e.g. mountain biking), in order to prevent losing hikers. This however may be an option at other places in Switzerland.
- Higher frequency cable cars and making slopes easier will channel skiers faster through the system.
- They regard independence within companies as valuable in deciding the best long-term strategy for them.

"We were in a very lucky situation, where we have a beautiful mountain, also in summer. So it was maybe easier for us to make or to take those decisions than it can be for others" (M. Eppenberger, Toggenburg Bergbahnen, interview 2016).

Communication with other Sectors

A rising snow line is of course, not just affecting Swiss ski resorts. Switzerland, naturally has competition from the Italian, French and Austrian ski sectors. Awareness of resort practices from neighbouring countries do exist, although better regular communication across borders could enhance alternative strategies to a common problem.

Figure 4.2: Toggenburg ski resort, Wildhaus, Alt St Johann (company website).

The second Case Study we selected focuses on Disaster Risk Reduction, interwoven with Climate Change Adaptation, specifically regarding flood risk. The interview this time was conducted at a Federal Level and gives an interesting contrast in terms of perspective, to Case Study A. It could be argued that while the perspectives of Case Study A are “bottom-up” in nature, Case Study B is essentially “top-down”. However, the same sentiment was echoed in both cases: That you cannot fight nature if you expect to win long term. Adaptation within the current system, its governance structures, budgets, science dissemination activities and achieving effective public understanding of issues is key to finding long term solutions.

Results from both case studies go on to inform answers to questions raised within the Conceptual Framework (Chapter 3). The themes it maps out in terms of addressing gaps with CCA and DRR are explored in turn, wherever possible drawing on direct examples from the Case Studies. A final, third Case Study follows which specifically looks at trans-boundary issues from a Swiss perspective, in management of not just flood risk, but amenity and other uses within a CCA/ DRR context.

Case Study B: Managing Flood Risk in Swiss Towns and Cities

Disaster Risk Reduction- Perspectives from the Federal Level, Carlo Scapozza, Director of Flood Protection (*Hochwasserschutz*), Federal Office of the Environment (FOEN). Interviewed February 2017.

This section uses Flood hazard as a lens by which to magnify the Swiss system for CCA and DRR practices. Flooding is perhaps Switzerland's most potentially widespread hazard (Chapter 1), capable of affecting the majority of the Swiss population, and it is therefore a good indicator for highlighting aspects of the system which currently work well, or those which might be improved.

The Swiss governance system is clearly structured into three-political tiers (Figure 4.3) The Federal level makes or changes law. Responsibility for flood protection however, lies with the Cantons. The Federal level will assess and review which actions the Cantons decide to take, in terms of projects and other measures, but the actual responsibility for delivery lies with the Canton.

Each Canton defines in their own law if they will take a particular measure for flood protection, or if they will delegate this role to the municipalities (Chapter 2). Each canton however is different in terms of delegation, so flood protection measures will either be taken at the Cantonal level or at the Municipal levels, but never at the Federal level. Financing for flood protection measures is split roughly at one-third for each level (Figure 4.3).

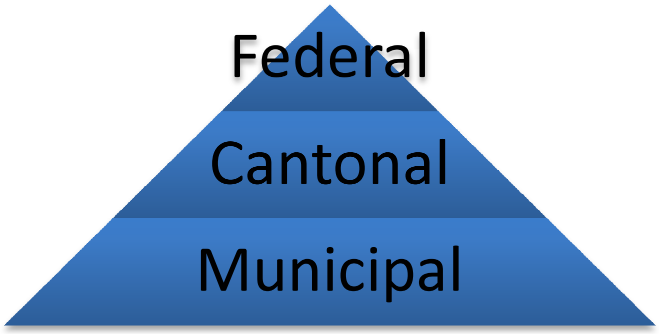


Figure 4.3 Conceptual Swiss governance model

The Federal Level pays approximately 40% or 1/3 for the implementation measures to their policies. There exist two levels of projects:

- Larger projects > 5million CHF, where Federal staff will speak with the Canton and give formal appraisal before work begins.
- Smaller projects < 5million CHF which are assessed under a 4 year contract (currently running between 2016-19) The Federal office will inspect these annually, but the Canton oversees project management.

One critical aspect of the Federal role is to overview projects, keeping a strategic perspective, alongside helping to finance projects to mitigate flood risk. They assess and uphold effective functioning of the system. They ensure measures taken are cost-effective and that projects develop within legal guidelines.

The insurance industry has a key role to play in this governance relationship and is relatively prominent in being proactive in Switzerland, as opposed to other European countries. There is a relatively high responsibility placed on insurers in Switzerland within CCA and DRR, particularly in terms of influencing behaviour of the private owner.

There is however no Swiss-wide obligation to be insured, contrary to some reports. Each Canton has its own law regarding this- currently around 5 Cantons do not impose an obligation to be insured. There are different types of insurance options available too, ranging from Cantonal building insurance to private insurance- it doesn't necessarily have to be Cantonal insurance that a home owner chooses, depending again, on their Canton's law.

- ☐ Flood risk in Zurich, Switzerland's economic centre- past and present

Whilst the Federal Office for Environment (FOEN) can and does provide advice to citizens, often the best understanding of a hazard is regarded as the experience of the event itself.

"The best sensibilisation (of risk) is a flood" (FOEN, 2017 interview).

However, memory of these events is sometimes short-lived. For example, after severe flooding of the River Sihl in Zurich in 1910, entrances to new houses near the main train station were, for several years later, built up higher with steps fitted, allowing effective protection (Matthias Oplatka, FOEN 2015 and pers. comm.) As the flood slipped from memory, though, entrances and functional spaces in buildings dropped back down to street level. The centre of Zurich, especially around the central train station (Hauptbahnhof) is still a high-risk area for flooding today, not because of a changing threat level necessarily, but because of the exposed assets located close to the confluence of the Limmat and Sihl Rivers (Prior *et al.* 2016). Zurich could face significant costly damages in the event of flooding, as Box 1 illustrates.

Box 1: Zurich Flood Risk (main rail station) Disaster Risk Reduction

According to the SBB Media Department, Zurich's railway junction could be brought to partial or complete interruption by a flood. The impact on rail travel throughout Switzerland would be huge. Around half of the journeys made by approx. one million passengers who use the SBB every day take place in the Zurich region.

The SBB expects that from a discharge rate of between 360 and 400 m3/s, the Sihl river would breach its banks on the southern edge of the city. Between 30 minutes and three hours later, the flood would reach Wiedikon railway station and shortly after the tracks in the main station. The underground systems would also be affected. The actual flooding of the underground stations and tunnels would unfold over a period of several hours to up to one day. The new Löwenstrasse station, the Museumstrasse suburban rail station and the railway tunnels to Oerlikon and Stadelhofen would also be affected.

The SBB does not expect any injuries to persons in the event of a flood as an evacuation system is in place throughout the entire main station. People in the halls and corridors and in the shopping areas can be kept informed about the nature of the event using pre-recorded texts in German, French, Italian and English. Evacuation of the main station would be ordered by the senior management of the city of Zurich and the SBB's emergency or crisis team.

Article from FOEN, 2015.

***Natural* Hazards.**

Figure 4.4 (right) Zurich's "lucky escape" in August 2005 where the Sihl/Limmat Rivers converge at Zurich's main station. Only a last-minute weather reprieve prevented the Sihl from breaching its banks (source M. Oplatka) AWEL, the canton of Zurich Office for Waste, Water Energy and Air (courtesy of FOEN, 2015).

4.1 Challenges and gaps related to governance in existing legal, policy and science approaches

4.1.1 Institutional Barriers

Switzerland, like all countries has its share of institutional barriers. From a Federal perspective, there is a regulated advisory flow of information down from the Federal Level to the Cantonal level, but this is not always translated beyond to the municipal level where implementation is mostly likely to take place, due to differential practices and decisions by the Cantons. This may lead to patchwork practices and potentially a lack of communication to where it is needed most- to the policy implementer.

One example emerging from interviews, is investment decisions taken at the Cantonal level can sometimes be misaligned with individual stakeholder opinions, seen sometimes to be short sighted, e.g. schemes funding local farmers to run snow-machines at lower elevation ski resorts, or by investing heavily in improving winter facilities at resorts whose ski seasons are already shortening to the point of financial stress. The snow line will keep rising in Switzerland and more sustainable options need consideration and full discussion at a local level so stakeholders can participate in making the best decisions for their region.

4.1.2 Funding Arrangements

Protective infrastructure investments, have been a central part of Switzerland's disaster risk prevention measures (OECD, 2017) but much of this infrastructure was constructed since the 19th Century and is now aging, built in response to disasters as opposed to being developed in a forward-looking manner which takes long term risk evolution into account (OECD, 2017).

Approximately 2.8 billion Euro is spent on natural hazard risk management in Switzerland every year. Of this, 1.6 billion Euro is raised by private individuals, of which 830 million Euro is covered by insurance companies. These costs are counter-balanced by enormous benefits (FOEN, 2015). These are generally difficult to quantify as avoided costs do not show up on any balance sheet. However, they can be estimated in some cases. For example, 25 million Euro was invested in the structural measures for protection of the commune of Buochs on Lake Lucerne against flooding of the river Engelberger Aa. During the first subsequent flood event of 2005, this investment prevented damage, estimated in the region of 150 million euro (FOEN, 2015).

Switzerland is a best practice example in terms of achieving near-universal coverage against natural disasters through insurance. Swiss citizens and businesses enjoy affordable access to full coverage of possible damages caused by the majority of natural hazard events (OECD, 2017). Individual citizens are also expected to contribute to overall safety levels by investing in safety measures for their properties (OECD, 2017).

Yet policy, is still catching up it seems with practice (see Case Study B). As stated, insurance and funding decisions often fall to the Cantons. This has led to different schemes being prioritised not just within but also between Cantons, depending on decision-makers' perspectives at this level. Ski resorts are one example where significant investments may be made at resorts whose Winter seasons are already shortening and where their ski runs will, in forthcoming years fall below the rising snowline. These projects can sometimes involve millions CHF and yet might be unsustainable in the medium-longer term (40-50 years).

OECD (2017) also acknowledges that the flow of financial contributions by different actors is not complete. Reviews on total budget allocation for risk prevention, for instance, are not done on a regular or systematic basis. Even the current picture on public funding flows is rather fragmented, which they suggest makes steering of funding towards priority projects sometimes difficult (OECD, 2017). They recommend centralise and regulate collection of funding information across Cantons and other NGOs to better-prioritise spending (OECD, 2017).

4.1.3 Political will/Motivation

Climate change is a growing political concern. In Europe, this is fairly evenly recognized and seen as a shared problem to resolve. Switzerland fits with this general trend and it contributes to reduction of carbon emissions.

In Switzerland however, there is a shared and conscious "whole of society" will -spanning policy and society- to address Climate Change. Disaster Risk Reduction is swiftly following and there are synergies emerging between the two, as they make advancements via shared resources such as an internationally-connected science program, shared funding and multi-level cooperation.

The tourism lobby in Switzerland is strong. This can potentially place pressure on sustainable decision-making. There is an impression, sometimes fueled by media that Swiss ski resorts are "too important to fail". Elected politicians and media figures have ability to influence these attitudes, in terms of raising awareness of alternative measures and longer-term, more financially sustainable (and perhaps more environmentally-friendly) schemes.

Toggenburg Bergbahnen, for example, is a private company, and not directly politically-linked. They have freedom to implement their own measures, deciding what works best for their company. They note however, that some of their tax money goes towards funding shorter-term measures (e.g. snow machines) in competing, lower resorts. This might seem at odds with their intention to work towards longer-term, more sustainable strategies.

There is perhaps a potential conflict between a company pursuing a longer-term strategy, whilst (indirectly) financing unsustainable, shorter-term "measures" due to investment decisions made at the Cantonal level. This suggests a gap between strategic decision-making and local implementation of measures for adapting to climate change. There is no "one size fits all" approach to solving CCA issues, but a full and fair appraisal of different local schemes is likely to yield sustainable decisions. Sometimes, long-held visionary plans and strong cultural attachments to a region can overrule or obscure specific disadvantages of following shorter-term approaches.

4.1.4 Stakeholder complexity

There are always complexities involved in engaging with a large set of stakeholders and sectors. In Switzerland, there is however a relatively large degree of cohesion observed between sectors sharing a common goal. The insurance industry for example, is outward-looking in terms of playing its part and other countries can learn from these measures. The Swiss foster a whole-of-society approach to dealing with CCA and DRR and this therefore eases stakeholder attention or "buy-in" to CCA and DRR schemes.

That is not to say however that stakeholders always agree on the best way forward. Toggenburg Bergbahnen's business proposal, for example, to shift their focus to consider more equally the economic potential of non-snow days, (or focusing on summer tourism), took time to align their stakeholders in fully supporting this concept.

"Stakeholders", by definition can mean different things to different people, and can differ at various levels of governance. For example, in Switzerland, Cantonal level stakeholders are the municipalities, NGOs, infrastructure drivers e.g. Railway and transport companies. Within City of Zurich, for example, "stakeholders" might mean something quite different, including all users, inhabitants and commuters of the city region.

The important point is to find ways of knowing the interests of different stakeholders- their agendas and their priorities. Every stakeholder also has to want to be engaged. This cannot usually be forced, successfully. Solutions must be found which are acceptable to the majority of sectoral interests, if not all individual stakeholders.

"It is most important in a participative process that firstly the interests of the different stakeholders are known. The second step is that every Stakeholder has to want to participate, that the people involved are trying to look for a solution, the third is to look for a solution that can be acceptable- perhaps not the best fit- but it's what every stakeholder is able to accept, (not necessarily the same thing as best-fit) within legislative alignment". (C. Scapozza, FOEN, 2017).

Participatory studies into natural risk and resource management (e.g. Kuhlicke et al. 2011) and Buchecker et al. on an early warning flood system for the River Sihl in Zurich (personal communication), and by the project *GouvRhône* on the River Rhone on the Swiss-French border (C. Bréthaut, 2014), highlight the importance of proper participatory planning and how it can positively affect solution-sourcing. However, this is not necessarily always a necessity in terms of sanctioning work to be carried out:

"It is not a requirement to have success in a participative process" (Federal source)

There therefore needs to be careful synergy with *targeted* stakeholder engagement, rather than doing so in a generalised manner, simply to meet a project's criteria, with continuing involvement and education on the issue.

4.2 Challenges and gaps related to risk in the existing legal, policy and science approaches

4.2.1 Risk Perception

There are conflicting reports about Swiss risk perception. Federal reports will describe a growing awareness of readiness and personal responsibility among the public to mitigate effects from disasters, following well-channeled public advice (communicated via websites, well-defined evacuation routes etc). Yet some interviews highlight that in the case of individuals, members of the general public are increasingly unable to adapt as well as in the past.

Skiers and hikers for example are not always able to react if there is fog or strong winds in either winter or summer. People are less able to assess their situation and take their own decisions and precautions in protecting themselves at altitude. Neither will some ski clients accept closed slopes for avalanche risks. This sometimes puts companies under pressure, in terms of balancing perception of risk with realistic risk. In (over-) informing people and creating safer resorts, there is sometimes a risk of giving a deceptive impression of 100% protection.

A breakdown of how Swiss science investigates key aspects of Climate Change can be seen in Figure 4.5. Mitigation and adaptation technologies account for 5% of the total, a figure which can be improved upon with adequate prioritization of research funding, and also be strengthening ties to DRR.

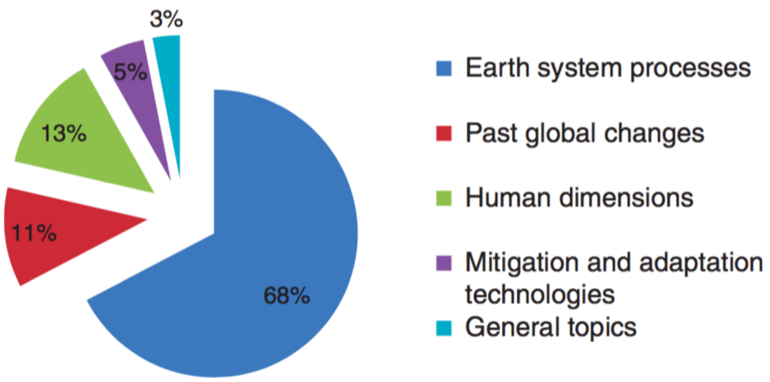


Figure 4.5 Percentage of scientific papers published by Swiss scientists in areas related to climate change. (Source ProClim, from Brönnimann et al. 2014)

The overriding question in terms of risk perception, within both the scientific and political community currently is: What is **acceptable** risk? (FOEN 2017, personal communication, Wyss, 2016, PLANAT, personal communication). What assets are acceptable to sacrifice in order to ensure the existing system capacity is not overloaded. Can we cope with those times of overload? How can we prepare to mitigate as best as possible for when those inevitable times arrive? Finally, how can each event teach us something new, how do we learn from disasters and use each as a tool by which to strengthen system capacity making it a little more robust after each disaster. In order to answer these questions, we must explore the links between them to expose the challenges and weaknesses more fully.

4.3 Challenges and gaps related to scientific frameworks in existing science approaches

Research institutions are increasingly aware that there is more they can do to address "science-policy-implementation" gaps. One Swiss example is The Mobiliar Lab for Natural Risks, a private public partnership hosted at Universität Bern. It was set up in 2013 to bridge the interdisciplinary gap between science and application http://www.mobiliarlab.unibe.ch/ (source, OECD, 2017).

In terms of trans-boundary knowledge transfer, the research platform, *Intrapraevent*, hosted in Austria, fosters scientific exchange between Swiss scientists and policy-makers at a global level, in researching natural hazards and risk reduction. FOEN organised their last meeting in Lucerne in 2016, the next will be in Japan in 2018. http://www.interpraevent.at/

FOEN encourages integration of science and policy by financially supporting research projects from Switzerland's academic institutions, particularly those which link engineering solutions with ecological considerations. An integrative science engagement procedure is in place and functioning well, with institutions such as ETH Zurich, University of Geneva, University of Lausanne and others benefiting. Practical-based research has been identified as sometimes very difficult to source money for project proposals so this is one area the Federal offices are more closely supporting.

Although Earthquakes, or large earthquakes are deemed to be relatively rare in Switzerland, they are recognised as the hazard likely to cause the largest damage, socially and economically (Section 2.1 a). OECD (2017) draw attention to the fact that only half of Swiss Cantons have established maps of seismic soil foundation classes or spectral seismic zoning studies to account for how local soil make affect the earthquake hazard in that particular region. They go on to state that these maps have only limited implications on zoning plans and do not lead to construction bans which could potentially lead to significant damage in a quake. OECD (2017) therefore recommend more attention is paid to seismic hazard when designing hazard maps.

As researchers we try to help everybody to have the same view about the issues, what should be the priorities- this is how science should help. (C. Bréthaut, GouvRhône project (2017, personal communication)

4.4 Challenges and gaps related to communication in existing legal and policy aspects

Media can sometimes over-sensationalise issues, trends and practices, which makes some stakeholders wary of engaging with them, particularly if they are individual businesses with perhaps a financial risk involved in communicating their plans. Media sometimes distort climate trends inaccurately, and might be seen to lend support to short-sighted measures (e.g. purchase of snow machines) in support of the tourist industry when longer-term, other solutions might be more suitable.

http://www.thelocal.ch/20170106/lack-of-snow-puts-visitors-off-swiss-ski-resorts

Prior *et al.* (2016) notes that trends and developments like high media exposure and the information and communication revolution, privitisation, politicization of crises and disasters, along with rising citizen expectations, have increased the complexity and pace of crisis phenomena.

Although Switzerland has embraced risk-informed land use planning based on hazard maps, some challenges remain. OECD (2017) identifies that while gaps in locally-available hazard and risk assessments have been closing rapidly for new construction projects, the same gaps are slower to close for older buildings. This is perhaps an issue for urban areas where housing pressure is felt highest.

OECD (2017) also acknowledges that integration of hazard and land use plans has not been carried out at the same pace across all municipalities and levels of government. They go on to note that in some cases hazard information in making land-use decisions appear not to have been fully integrated yet, or indeed their "full potential unlocked" (OECD, 2017). Whilst this might be expected to some extent, differential governance styles and decisions amongst the Cantons are likely to exacerbate this issue. Yellow zones, for example, on Swiss hazard maps which denote areas of minor hazard (shown in Figure 4.6) account for half of filed insured damage claims. OECD recommends speeding up the process to address this discrepancy, and to raise awareness for need to respect regulations even in low hazard zones (OECD, 2017).

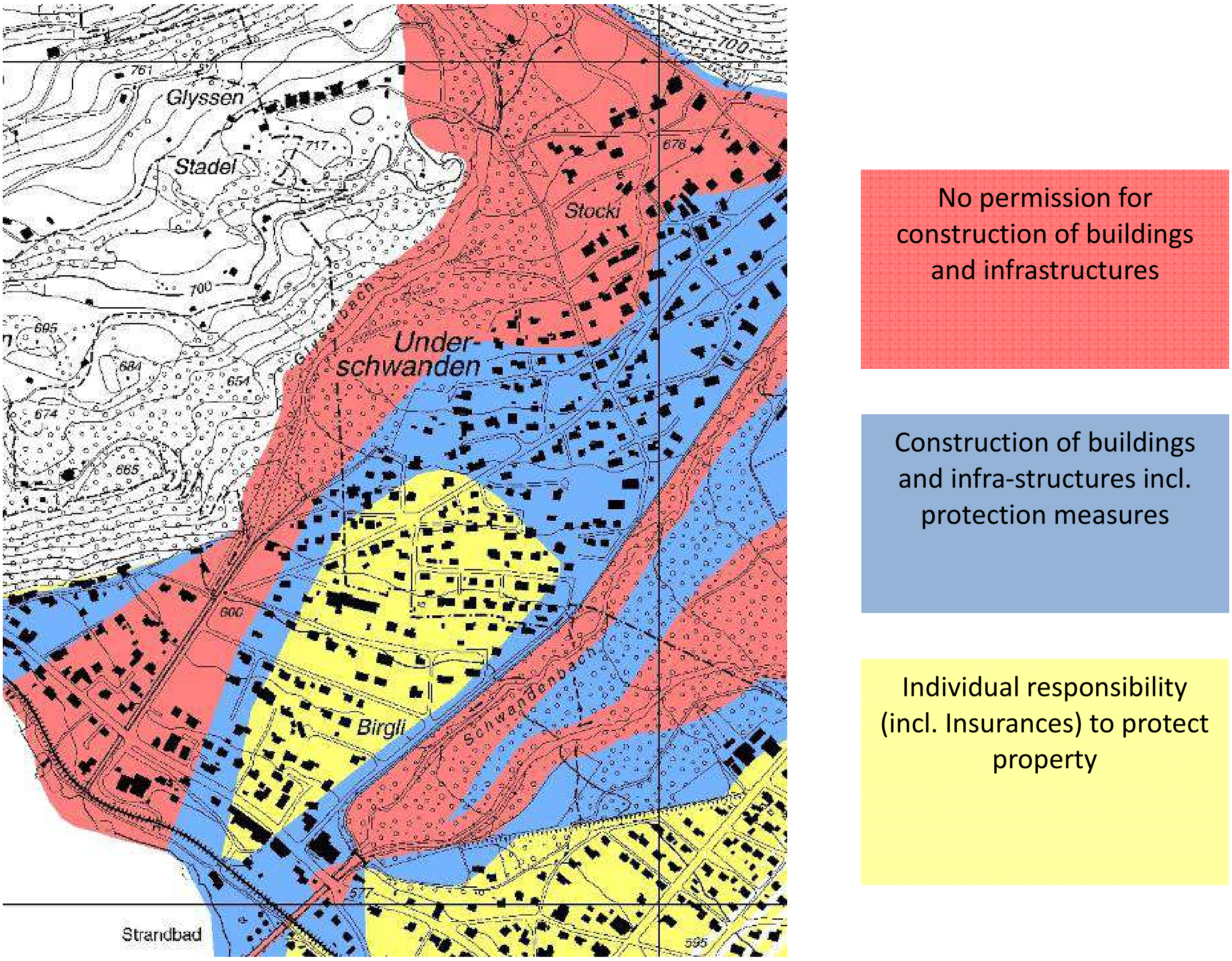


Figure 4.6: An example of a Swiss Hazard Map (image courtesy of Markus Wyss, PLANAT (personal communication). PLANAT presentation to the OECD Risk Conference, Paris, December 2016).

4.5 Other challenges or gaps in existing legal, policy and science approaches pertaining to key ESPREssO Challenges

4.5.1 Lessons from neighbouring countries

Switzerland can take positive aspects from strategies of neighbouring countries and implement these approaches into their own. Using examples from the neighbouring country of Austria, Prior *et al.* (2016) note that many operational aspects which contribute to preparedness at the local level, are led at the municipality level, with the state playing more of an advisory role. In Austria, the UNISDR initiative "Making Cities Resilient: My City is getting Ready", is remarkably popular with 280 municipalities represented (UNISDR, 2014).

http://www.unisdr.org/campaign/resilientcities/

Indeed, Tyrol (with all its municipalities) joined in entirety when this initiative began in 2010. Austria's strong localisation of preparedness and resilience-building is an excellent example showing that, diffusion of innovative initiatives among peers (in this case the municipalities) yields organisational flexibility to meet civil protection challenges as they are recognised, despite the fact that it might also lead to patch-work results with different levels of preparedness (Prior *et al.* 2016). It provides an interesting contrast, proving that there are different ways of achieving the same goals and that Switzerland can benefit from lessons learned across its borders, and vice-versa. Simply by increasing communication and awareness between national strategies enhances trans-boundary cooperative links, in preparation for times when it is perhaps urgently required.

4.5.2 Transboundary communication at the Federal and Cantonal Level

Switzerland maintains "good neighbour" relations with all its adjacent countries and has, for over a Century, engaged in joint actions to successfully manage cross-border lakes, maintain water quality/quantity, stabilise and reduce pollutant discharges to wider catchments of major European rivers and over the last 20 years or so, to increasingly address and align its CCA and DRR practices.

Switzerland's Federal Office for Environment engages in regular, successful trans-boundary communication and collaboration, within cooperative organisations such as ***Internationale Kommission zum Schutz des Rheins*** (IKSAR) http://www.iksr.org/de/index.html . This particular collaborative body covers not only flood protection, but also biodiversity and ecology – FOEN reports a particularly good exchange with Germany and the Netherlands under the umbrella of this organisation (Carlo Scapozza, FOEN, interview, 2017).

Transboundary communication regarding management of the large Swiss-border alpine lakes, namely Ticino (shared with Italy) and Lake of Geneva (shared with France) is a complex arena where environmental and economic pressures compete, e.g. flood risk management, crises management, use, amenity, and risk mitigation are all issues which span shared borders. However, divergent interests sometimes emerge in terms of governance issues, one example is regarding managing lake levels for different purposes e.g. nuclear power plants in France on the Rhone prioritise a certain flow rate and lake storage capacity that is sometimes at odds with flood defence mitigation measures (Case Study C).

There currently exist various separate international agreements, for maintaining water quantity and water quality between Swiss and French authorities. French authorities have recently expressed a wish for a more streamlined agreement on these topics in order to have a better coordination between policies, whereas the Swiss are preferring to work to existing agreements, to avoid radical or rapid change; to focus instead on increase capacity of the existing system in order to be able to accommodate a certain degree of overload in times of crisis e.g. drought.

"At the moment we don't change the rules because of climate change but we want to introduce more flexibility in the case of a crisis situation. We want to have a system that can be overloaded without catastrophic failure". **C. Scapozza (FOEN, 2017 interview).**

Case Study C: Swiss trans-boundary communication and governance of trans-border alpine lakes and transboundary rivers.

A Researcher's perspective: Dr Christian Bréthaut (*GouvRhône* Project)

Geneva Water Hub, University of Geneva.

The Rhône river basin is shared between France (90'000 km^2) and Switzerland (7'800 km^2). The Swiss part of the Rhône is used mainly for agriculture upstream of Lake Geneva, and for hydropower production in Geneva itself (Bréthaut, 2013), where river management is delegated to a semi-public hydropower company (Services Industriels de Geneve). The French manage the river from the French-Swiss border to the Mediterranean Sea, its main uses/ sectoral demands being hydropower, nuclear power, fishing, navigation and irrigation (Bréthaut, 2013).

Figure 4.7: Rhône river basin and main hydropower infrastructures from Geneva to Lyon (modified from GRID-UNEP 2007 and Storck et al. 2004, from Bréthaut, 2013).

The Rhône river has a highly-fragmented governance system, characterized by complex, interconnecting public and private laws. Bi-lateral agreements have existed between different stakeholders for many years, reached by negotiations between key operators, but these negotiations were not necessarily open to all. It therefore became difficult to build a realistic picture of the "state of play". Private law agreements added a complicating factor (Figure 4.8) to trans-boundary transparency and communication issues in the region, which needed resolving.

"One of the first things we found when we started to work on the Rhône river is that it was quite clear that the (nuclear) operator has to cool down the nuclear power plants, that's an obvious issue of nuclear safety, but, the French state did not have a clear view about how the transfer of water was operated in order to cool down the system, because the transfer was relying on private law agreement" (C. Bréthaut, personal communication, 2017).

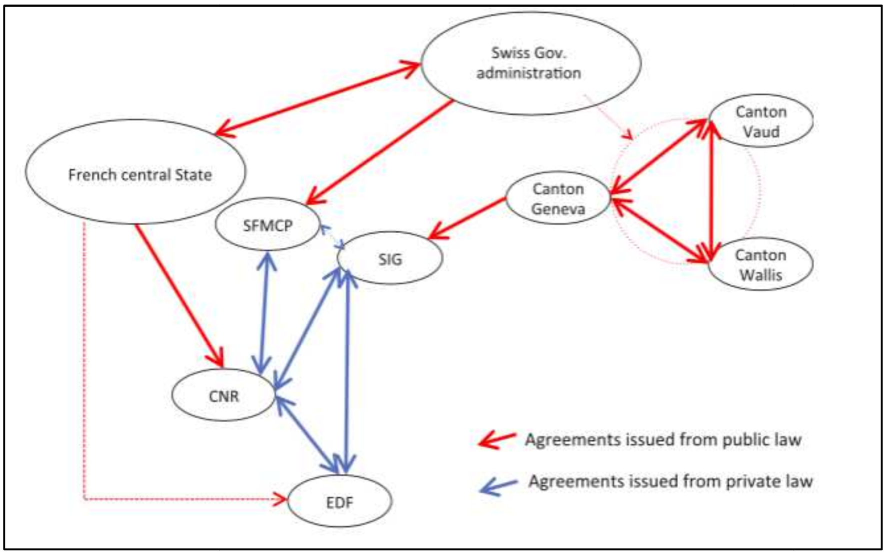


Figure 4.8: Governance structure and actors configuration of the Rhone. SIG (Services Industriels de Geneve), CNR (Compagnie Nationale du Rhône) EDF (Electricité de France) (Bréthaut et al. 2013)

THE PROBLEM: The Rhône - an interesting example of a river basin with no institutionalized transboundary management of the river (only sectoral agreements) (Bréthaut, 2013). There are few (or no) actors with a global view of the river's governance and no regulatory institution at the river basin scale.

At the Cantonal level for example, Geneva is collaborating every day with the French parties because the Canton of Geneva is closely interlinked to France, (via) a lot of River contracts, which are signed by the Canton and France, you have the (Genevese) aquifer between the Canton and France. But this was not the case for the Rhone. So discussions about upstream-downstream coordination was very relevant." (C. Bréthaut, interview, 2017).

SOLUTION: In May 2012, "*GouvRhône*", a public project, led by researchers at University of Geneva and University of Bern, ran for 36 months, drawing together project partners from the Swiss Federal Office for the Environment, French Water Agency, Canton of Geneva, Canton of Vaud, Industrial Services of Geneva, Electricité de France (EDF), International Commission for the Protection of Lake Geneva's Water and others. The project focused on the operational governance on the river, and therefore the major operational sectors e.g. hydropower, nuclear and regional and national state authorities.

TASKS:

- Connect stakeholders and discuss issues
- Get a better understanding of the functioning of the system itself, from the legal and public policy point of view, but also the power-balance between different stakeholders, what was the configuration of actors?

Define options for the future.

Different scenarios explored how stakeholders might make decisions based on a higher intensity of competition for resource. Three kinds of governance models were developed- 1) polycentric model (today's situation) where an arena of decisions are more/less coordinated, 2) mono-functional model- where governance of the system is viewed through perspectives of sectors of activity, looking at the river as a system of production not necessarily as a "hydro-system". 3) Integration- with a reinforced position of the authorities within the governance system.

GouvRhône notably performed successful stakeholder analysis assessing the Rhône's diverging interests and achieving building of a platform and a "new arena" for Stakeholder communication between Swiss and French authorities (C. Bréthaut, University of Geneva (UNIGE), personal communication). In order to achieve this, *GouvRhône* led a governance analysis of the system and a study on climatology on evolution of mean flows on the river, projected to 2100, then combined the two studies.

"They are working on the issue at the national level- this was one of the big issues for GouvRhône, that on both sides you have institutional frameworks which tends to integration- working quite well- with strong public policies… but then you have a lack of institutional framework on the trans-boundary level. It's kind of intermediary space and they really don't know how to address this space, specifically regarding the Rhone river" (C. Bréthaut, interview, 2017).

Since the 1960's, the International Commission for the Protection of Lake Geneva (CIPEL) has functioned well in addressing water quality issues where actors have had ample opportunity to interact, but regarding quantitative issues there was no arena where stakeholders could interact in a formal way. *GouvRhône* provided this, where stakeholders could interact on quantity issues, and this was welcomed and well-participated in. The project was funded by Swiss and French Authorities and the operators themselves. That meant close interaction with the different sectors and a great deal better transparency as to how the whole system was working, which had not been so clear at the start of the project.

	Mono/ multifunctional regulations	Included/excluded users	Private or public actors involvement	Spatiality
Phase 1 1870–1970	Monofunctional regulation	Included: hydroelectricity producers Excluded: environmental organisations Absent: nuclear energy producer	Switzerland: public actors as manager and regulator France: private actors and self-management	Management at the basin scale in France only (through CNR concession) no transboundary agreements
Phase 2 1970–2000	Multifunctional regulation of few water uses	Included: hydroelectricity producers nuclear energy producer Excluded (but emerging): public administrations responsible for environmental preservation	Switzerland: public actors as regulator/semipublic actors as manager France: on a sectorial basis private actors and self-management	Transboundary agreements existing on a sectorial basis
Phase 3 2000-ongoing	Multifunctional regulation of heterogeneous and complex rivalries	Included: hydroelectricity producers nuclear energy producers public administrations in charge of environmental preservation Excluded (but emerging): environmental organisations	Switzerland: public actors as regulator and manager (for environmental issues)/ semipublic actors as manager France: private actors as manager/ public actors with reinforced regulatory power in energy and environmental fields	Attempt to define new transboundary institutional mechanisms between public authorities

Figure 4.9: Evolution of Rhone river governance between 1870 and today (C. Bréthaut, 2013).

An increase in extreme climatic events (and after several notable droughts occurring since the early 2000's) has urged public actors to return to the table on redefining governance modalities of the river Rhone. Public actors try to find solutions which overcome the strong institutional fragmentation linked to the transboundary setting. They also aim to ensure stronger adaptive capacities by anticipating and answering potential tensions within actors' configuration (Villanueva et al. 2015).

The convention (*Mesures d'execution,* 2000) between the operators SIG, CNR and EDF, defines the only collaborative entity in existence for managing the Rhone in a transboundary perspective, managing conditions of water transfer downstream from Geneva (Bréthaut, 2013). It materialises implementation of a regulatory space dedicated primarily to the governance of energy production (nuclear energy or hydroelectricity) and resolution of upstream–down- stream homogeneous rivalries. In doing so, the *Mesures d'execution 2000* convention interconnects two geographical spaces separated by Lake Geneva. It redefines political boundaries on the basis of a multifunctional arrangement related to water rights (Bréthaut, 2013).

GouvRhône provided policy makers with **options** and practical advice on implementation opinions within the different legal frameworks (Swiss, French, Transboundary). Although the project has now concluded, it had tangible success in generating an arena for exchange which stakeholders can expand on moving forward.

"The argument at the end, was not that the whole system must change, a lot of private law agreements have led to a certain opacity but at the same time also a great flexibility and adaptive capacities which are in force because those private law agreements can be re-negotiated every 5 years, which is a huge difference between a public policy which can take a lot of time to modify" (C. Bréthaut, personal communication, 2017).

More discussion or negotiation arenas such as that provided by *GouvRhône* is therefore recommended, not just between national borders but perhaps at Cantonal borders too. These arenas allow sharing of best practice and finding solutions to common problems and is greatly encouraged in terms of offering mutual benefits.

"Miscommunication problems may arise between two different politic cultures: It was really striking and interesting to see- France's priority to find an agreement; On the Swiss side, before talking about the agreements, let's talk about the issues. The pace was different- the Swiss wanted to take their time in considering their options" (C. Bréthaut, 2017, personal communication).

Swiss-Italian Trans-boundary communication

Regarding FOEN's relationship with Italy, similar discussions take place as their French counterparts- although, instead of power plants, agriculture is a driving factor for policy change. Italians make requests for more water to be stockpiled in the late spring in order to have a ready supply available for the summer, available for agriculture, although the resultant higher lake levels would then pose a problem for flood protection, with less storage capacity available, so these competing priorities must be carefully balanced: Availability of water, against flood risk (FOEN, 2017). This shows that differing stakeholder priorities/ demands often has knock-on impacts to managing (flood) risk.

Summary

"Climate change" by definition may indeed be used as a driver to change the rules of governance between/ within borders. This may bring its advantages and disadvantages, depending on stakeholder priorities. This reflects earlier comments about maintaining an objective view towards change. Instead of bringing about significant policy change as a reaction to these changing climatic drivers, the Swiss are opting to simply increase flexibility in the current system: In the case of flooding, the aim is not to change the design quantity of water- but to have a system which can withstand periods of overload without failure and to know how to measure this in order to avoid disaster.

5. Discussion

This report is a synthesis of Swiss legal, policy, science and governance approaches to CCA and DRR. It is intended to be a summary of the most up to date information available. It signposts key reports, websites and other publications to help achieve a snap-shot of Switzerland's current status in aligning CCA and DRR practice.

By exploring three case studies, one related to longer-term Climate Change in Switzerland (adapting to reducing snow reliability), the other to Disaster Risk Reduction (flood risk mitigation), and finally to trans-boundary issues, we can see synergies and gaps emerging. During interviews, the same organisations, research institutes and (re) insurance companies were referred to. It makes sense to align activities and priorities where both sectors can draw on the same infrastructure, research, funding and expertise. A country with an adaptive approach to climate change, whether it be diversification in its ski resorts, or allocating sacrificial land for flooding, will find it easier to align CCA measures with DRR moving forward. As shown in Figure 2.9, the synergies between the 2 spheres lies within reducing vulnerability and increasing resilience. These should be seen to be common goals, from two sometimes quite differently sourced/ supported disciplines.

Hazard mapping, for example, which already has advanced coverage in Switzerland is one area where both CCA and DRR can expand synergies of interpretation and ease of information access to the public through online portals. This in turn supports awareness-raising and education which are essential to growth within the two sectors.

Perhaps one area for expansion is accepting that where CCA is heavily rooted in science and forecasting, and DRR in policy and response, encouraging cross-pollination of ideas between researchers and implementers (policy-makers) at all levels of the system is of immediate benefit. Some might argue that decisions made at a strategic level should be discussed and decided at that strategic level, but often, when multi-level stakeholder engagement is sought, or even insisted upon, objectivity and fresh perspectives generate novel and effective solutions. A two-way process is therefore ideal, where bottom-up or trans-boundary examples of DRR and CCA might help inform other regions, projects or countries to follow suit.

5.1 Eine Daueraufgabe! (A long-term task)

A general pattern is emerging in both Swiss Climate Change Adaptation and Disaster Risk Reduction policy and practice. There is increasingly less focus on hazard reduction (or trying to reduce the impact of a hazard itself), in favour of moving towards control of that risk, in terms of building flexibility and better capacity for coping with crisis events. The star (Figure 5.1) marks where things currently stand at present- in the heads of the policy-makers this shift is fulfilled (red arrow), yet in policy it has not quite yet fulfilled to the same extent. Policy is catching up (green arrow).

This process to convert policy has taken longer, creating somewhat of a policy paradox in the eyes of some stakeholders. Previously, they have been tasked to prioritise reducing, or constraining the hazard as their key role- in the last ten years there has been a clear change in strategy and attitudes have changed. Now the focus is more n preparation, capacity-building, resilience strengthening and control of risk. With a growing urban population, this is a timely and cost-effective means of funding implementation measures. Whilst flooding is shown here as the example hazard, this trend can be extrapolated to wider Disaster Risk Reduction in Switzerland in general, and indeed Climate Change Adaptation measures.

It is the intention of authorities to test exceeding of the systems, to overload it temporarily to ensure that it is robust enough to provide an adaptive capacity on top of what the design discharge is meant.

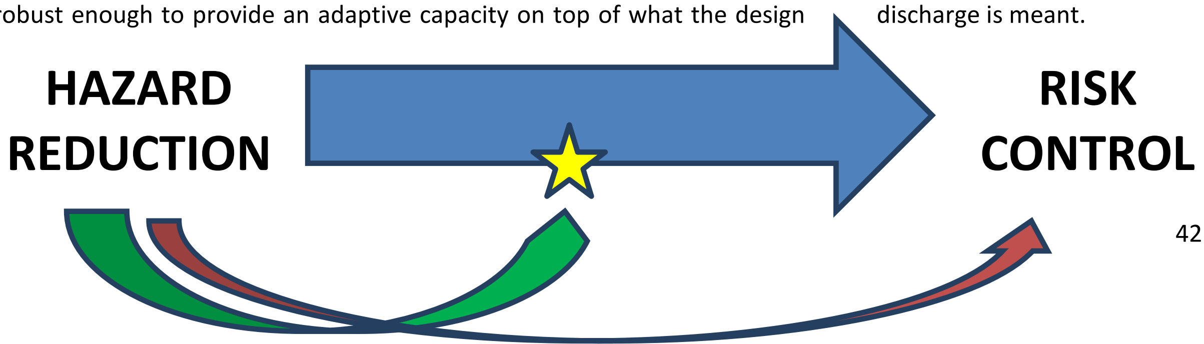


Figure 5.1: Changing attitudes in policy (green arrow) and perceptions (red arrow) within Disaster Risk Reduction and Climate Change Adaptation in Switzerland. The star is where Federal-level stakeholders believe we currently are.

The longer term task for Switzerland, as with many other countries, lies in balancing population growth, with its associated intensification of building, restriction of space and an increased demand on resources; with a changing natural environment and preserving its capacity to provide an expected level of amenity without catastrophic failure. This process requires to be carried out in stages, whereby infrastructure is developed to withstand increasing pressure gradually, and not overloaded prematurely which may exceed its original design limits leading to disaster. It is a complex balance to strike.

Clearly, risk infrastructure is well advanced in Switzerland, but it is an important balance to strike, implementing measures to protect people and the environment in which they live, whilst being careful not to portray total control over, neutralization or minimization of environmental hazards they should remain aware of (see Section 4.2.1). Rather than “risk control” as shown in Figure 5.1. risk “reduction” is a more appropriate term in defining the current goal of policy makers.

The recent OECD study (2017) raises several pertinent questions regarding common challenges in deciding on and implementing risk prevention policies in Switzerland. They highlight a need to:

- create sufficient awareness and determination within all sectors of a state (in Switzerland’s case meaning including federation, cantons, communes and the general population)
- to enforce risk based land use (in an effort to avoid new unaccepted risks), to maintain the achieved safety level which currently exists and to ensure the maintenance of protection infrastructure.
- to provide necessary financial and human resources for implementation

The main goal from reports such as OECD, and stakeholder interviews, is to reduce vulnerability to an acceptable level, working within the constraints of the current system, but testing capacity, expanding it where possible to deal with events that may place it under strain.

Examples of Swiss best practice identified by OECD (2017) in terms of lessons learned in risk prevention that can be transferred and applied to other countries include (source: Wyss, 2016):

- a thorough and consistent "top down" legal framework
- natural hazard mapping as a basis for risk identification and spatial planning
- prioritize "avoiding risks" (reduce existing, avoid new damage) by restrictive spatial / land use planning
- conduct event analyses (continuous learning process)
- strategic and operative controlling to improve strategies and best practice
- shared financing of the integral risk management
- involving insurances into the entire risk management process.

5.2 Sectoral interactions

Inter-sectoral relationships is an under-reported, key frontier for easing synergies between DRR and CCA. Figure 5.2 tries to show this conceptually, represented here simply by a sample selection of 3 sectors- all of which have important roles to play in synergizing CCA and DRR: e.g. Finance/ insurance industry, scientific community and governing body. These are all separate entities, discrete bodies, with their own agendas, who can exist separately from each other to a certain extent should they wish.

However, when facing society-wide threats (such as a changing climate and its knock-on impacts), these sectors recognize the merit in coming together to work towards a common goal- they essentially become "cogs", in a much larger system which has a clear joint-purpose, in this case, hazard mitigation or climate change adaptation. Whether or not that "system" is indeed CCA or DRR or something else, it is essential to know 4 things:

1) The **size** and **shape** (character), **remit** and most importantly the **boundaries** of each sector- where does their remit end? Where do *they* think it ends and does this match with other sectoral assumptions of their activities?
2) **Prioritisation** of their roles in any such system (i.e. how big a "cog" are they in such a CCA/ DRR "wheel").
3) How they **inter-link** with the other sectors- where are the "teeth" which connect them and secure their cooperation with other sectors? Can more "teeth" be added to help them engage? Or are there too many which need refining to make smoother connections with surrounding "cogs"?
Fiinally, and perhaps most importantly, for the synergizing aims of ESPREssO:
4) Where, and what, are the **linking forces** that make these sectoral "cogs" turn efficiently and smoothly? (i.e. the arrows in Figure 5.2). What drives these forces and where do they come from? Drivers in the case of CCA/ DRR can be climatic or political change, to list two examples.

Contrastingly to the linking forces, a system needs to be aware of where potential "spanners" might be thrown in the works also. Perhaps these might be physical barriers, for example a trans-national border, or social, such as a lack of motivation from certain sectors which might slow down the whole process.

What is essential is to de-lineate, re-inforce and define not just the boundaries of sectoral activities and roles (the cogs and the interconnecting arena), but the driving links between them, to make them turn and produce results. In other words, not to view systems *sectorally*, but more holistically, for all involved.

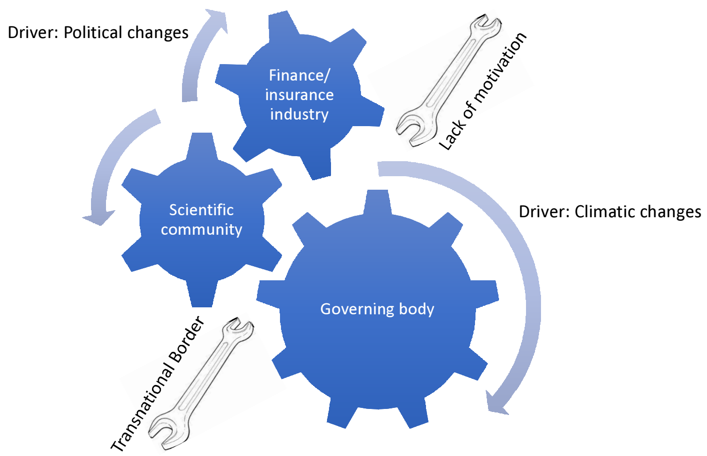


Figure 5.2 Conceptual model showing sectoral interactions (in this case for CCA and DRR synergies).

This concept is echoed in the case of Switzerland in particular. A recent study which assessed adaptive capacity of sectors and organisations to Climate Change risks in Switzerland (Jörin et al, 2016) looks at various levels of governance, across public and non-public organisations to reveal where gaps, or "system constraints" currently lie in dealing with specific climate risks (Figure 5.3). Key findings from this study show that federal offices have higher adaptive capacity compared to cantonal offices and municipalities. Furthermore, the public and non-public organisations, except federal offices, have limited adaptive capacity to 'new' climate risks. The issue is that for emerging climate risks, such as changing habitat or greater heat stress, there is still a lack of causality of 'what' leads to 'what'. Hence, organisations, except federal offices, are reluctant to perceive those climate risks as problematic. This limited risk perception of ‘new’ climate risks directly affects the provision of key adaptation factors, such as knowledge, finance, technology, etc.

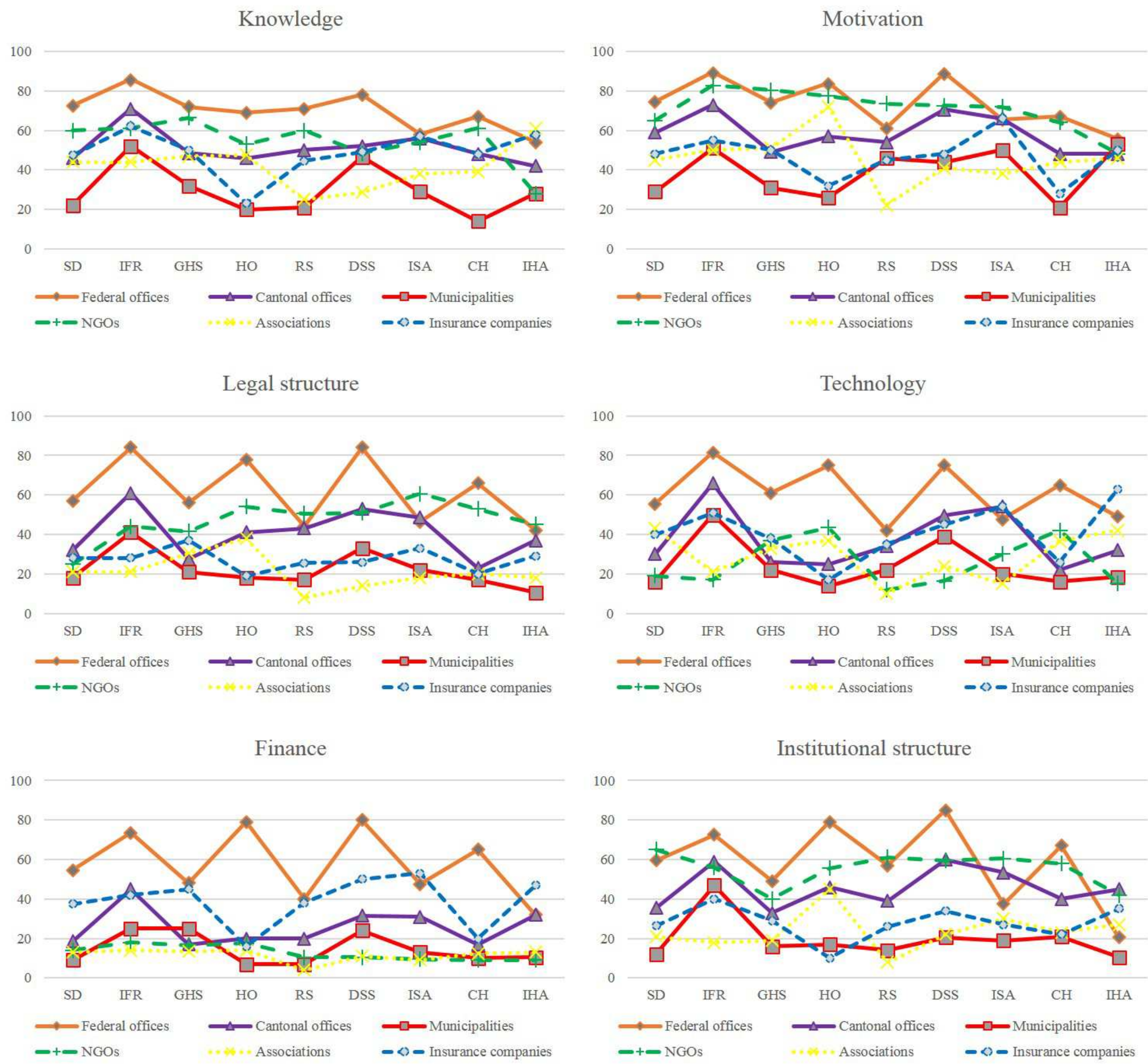


Figure 5.3: Adaptive capacity levels of public and non-public organisations in relation to key climate risks. A value of 0 means ‘no availability’ of a factor whereas 100 means ‘full availability’. Values represented in this figure refer to median values of each organisation type. The climate risks are: Summer Drought (SD), Increase of Flood Risk (IFR), Greater Heat Stress (GHS), invasion of Harmful Organisms (HO), Rising Snowline (RS), Decreasing Slope Stability (DSS), Increasing Storm Activity (ISA), Changing Habitats (CH), Increasing Hail Activity (IHA).

These findings can be nested within the global picture provided in Figure 2.10 (Chapter 2) to show how Switzerland’s challenges compare with those of the wider world. In summary, Figure 5.4 identifies where further work is needed to address these gaps in the Swiss system, based on the opinions of its own sectoral representatives (Jörin et al, 2016).

	Knowledge	Motivation	Legal structure	Technology	Finance	Institutional structure	Overall adaptive capacity
Greater Heat Stress	X	X	X	X	X		low
Summer Drought	X	X	X		X		medium
Increasing Flood Risk		X			X		high
Decreasing Slope Stability		X					very high
Rising Snowline	X	X	X		X		medium
Changing Habitats	X	X	X		X		low
Harmful Organisms	X	X	X		X		low
**Increasing Storm Activity*	*X*						*high*
Increasing Hail Activity	X	X	X	X	X	X	medium

X = constraints exist

**Climate risk is disputed*

Figure 5.4: Adaptive capacities in Switzerland for various climatic risks within the spheres of knowledge, motivation, legality, technology, finance and institutional structure (Jörin et al. 2016)

The level of adaptive capacity depends on the extent to which a specific climate risk is regarded as relevant. A lack of understanding surrounding causality of climate risks, or cascading effects one impact might have on another, and risk perception of organisations, directly influences the level of adaptive capacity of organisations. Jörin et al. (2016) study concludes that further research should look at whether cantonal offices and municipalities should receive greater responsibility in conducting adaptation process in Switzerland.

In summary, broader holistic and interdisciplinary approaches are needed in Switzerland to adapt to climate risks. Further research should investigate to what extent a greater number of different sectors can jointly develop and implement adaptation measures and strategies.

Future research questions should therefore consider the following, according to Jörin et al. (2016):

- What are concrete incentives and interventions that effectively stimulate (proactive) adaptation processes to climate risks?
- Is there a need for more federal laws that regulate responsibility for adaptation to climate change? Should cantons receive more responsibility in adaptation processes?
- How can interdisciplinary and transformative processes be triggered in the field of adaptation to climate change in Switzerland?
- What are the specific roles of different actors (organisations) in adaptation processes to different climate risk?

6. Conclusions & Recommendations

The following conclusions advocate freedom of information and stronger links between the strategic and local approaches to CCA and DRR in Switzerland.

Some key recommendations made by the OECD 2017 report, which this report would echo, are as follows:

Strengthen the evidence base on the potential occurrence and costs of disasters

- Enhance understanding of the possible linkages and cascading effects of natural disasters and risks highlighted in the Swiss national risk assessment including pandemics, power outages or nuclear accidents.
- Establish a more systematic approach to disaster loss data collection, especially with regard to socioeconomic impacts, across all cantons, including those where the natural hazard insurance is not organised by public insurance companies.
- Expand the current natural hazards (WSL) database to also include socioeconomic damages caused by disasters stemming from meteorological and earthquake hazards, and consider including indirect economic losses.
- Ensure that disaster risk management operates at adequate scales to strengthen particularly cross-jurisdictional risk prevention actions and transboundary cooperation in risk management. .

There needs to be better synthesis between strategic decision-making for CCA measures, with local or municipal schemes/ practitioners. Local strategies could offer new insight into fixing strategic "problems" e.g. offering ideas for stabilizing income/ investment in the tourist industry within a changing and more unpredictable climate. Ideas tend to be generated at the level most affected, so individual companies often develop novel strategies. A way of sharing these good-practice stories within Switzerland and trans-boundary, would be beneficial.

Prior *et al.* 2016 recommends building capacity of local municipal representatives and volunteer fire and civil defence personnel to help householders and communities to prepare for potential disasters and they propose that the federal government and cantons could help facilitate this.

Swiss hazard maps are of high quality and their benefit is clear and unchallenged, but some improvements might be of value. Kunz (2008) explains that visualisation of synoptic hazard maps is a challenge due to the amount of complex information they contain and advocates new digital ways of displaying these complex maps to help facilitate their interpretation. Indeed, this is an issue which can be explored longitudinally, distilling complex information (perhaps about a specific hazard in a specific location) to end-users with different professional backgrounds. Stakeholder communication is an area which can always be improved. Visualisation and 3D modelling offer one such opportunity for filtering of hazard information and allow complex information to be understood immediately.

The "whole of society" approach mentioned in the Introduction to this report, as the phrase chosen by OECD (2017) to describe Switzerland's approach to risk prevention, has several recognised advantages, such as Federal and Cantonal parliaments being able to jointly enforce the legal framework and laws related to risk management, they also report good risk awareness within Swiss society, despite other studies perhaps warning about temporary awareness. Shared financing of operational measures between the Federation, Cantons and municipalities is also regarded as a success, along with participation of affected population in planning protection measures. Finally, the strong support of the Insurance industry supporting Federal and cantonal efforts provides not just additional financial support but has an important awareness-raising role alongside.

Trans-boundary issues in Switzerland may, of course, not always be across international boundaries, but inter-cantonal issues, differences in decision-making, which can potentially lead to a jigsaw approach to either CCA or DRR. However, in reality, advice is readily passed down from the Federal level and it is up to the Cantons how they implement measures based on this advice. Flow of information back up from municipal level, via Cantons to the Federal level is not always as efficient.

Although the Cantons are autonomous in their relations with neighbouring countries, they have not always been fully associated into negotiations on major international conventions- this can cause delays which might be detrimental to implementation of international environmental cooperation (OECD, 2013).

ESPREssO will try and ease communication channels between CCA and DRR stakeholders in Switzerland to see where joined-up thinking can be of mutual benefit. This is of particular opportunity within research environments and institutions. (Inter) national events which highlight good practice and encourage dialogue on a variety of implementation issues for both CCA and DRR within the same arena, are also a good way of identifying new synergies. When stakeholders are encouraged to interact, there is a certain degree of reflection on how their own activities are perceived by other sectors, often leading to self-aware policies and a greater willingness for collaboration. Therefore clear distinctions between sectors and their remits within CCA and DRR would be helpful.

In conclusion, Switzerland's civil protection reforms and advances are in line with observed international practices and trends (Prior *et al.* 2016). Switzerland also matches many countries in developing new approaches around encouraging local preparedness for hazards and threats. Having said this, Prior *et al.* (2016) also note that these approaches are driven less by pressures associated with financial efficiency, than by recognised importance of preparedness within the population, in particular the responsiveness and recovery potential this preparation yields. They go on to say that Switzerland therefore has an opportunity to take reform action without the disruption an actual crisis or disaster might bring (Prior *et al.* 2016). This is an positive current position from which to face a changing and unpredictable climate and intermittent disasters a growing population might have to face in future.

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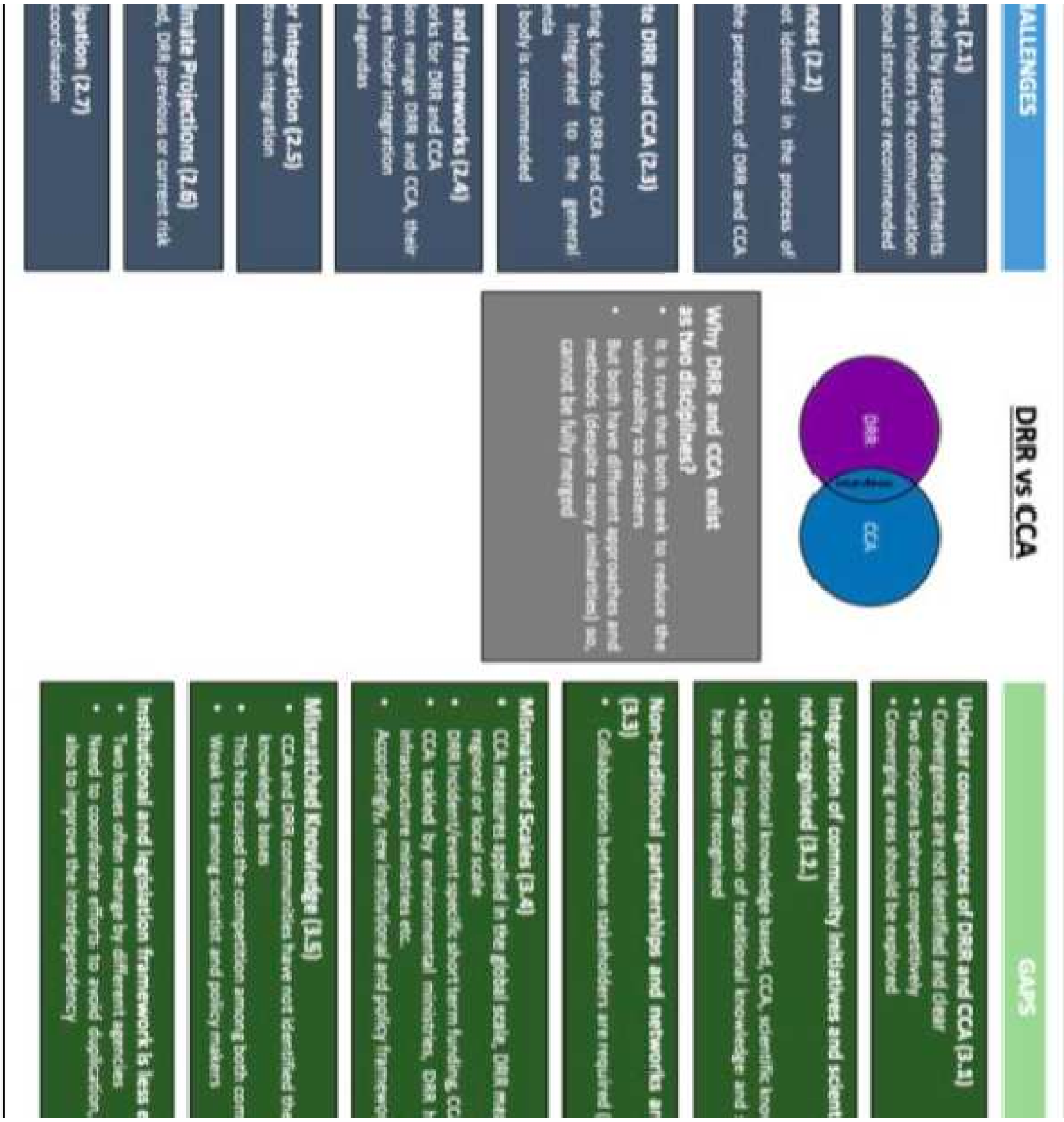
Annex 1: CCA/ DRR Conceptual Framework

Challenges and gaps to integrate CCA and DRR- from ESPREssO's Challenge 1 internal report, 2016.



Annexture 05

Synthesis report of legal, policy and science approaches within the frame of disaster risk reduction and CCA

Deliverable 2.1- National Report

United Kingdom

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April, 2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 700342. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein

Table of Contents

1 Introduction

1.1 The United Kingdom

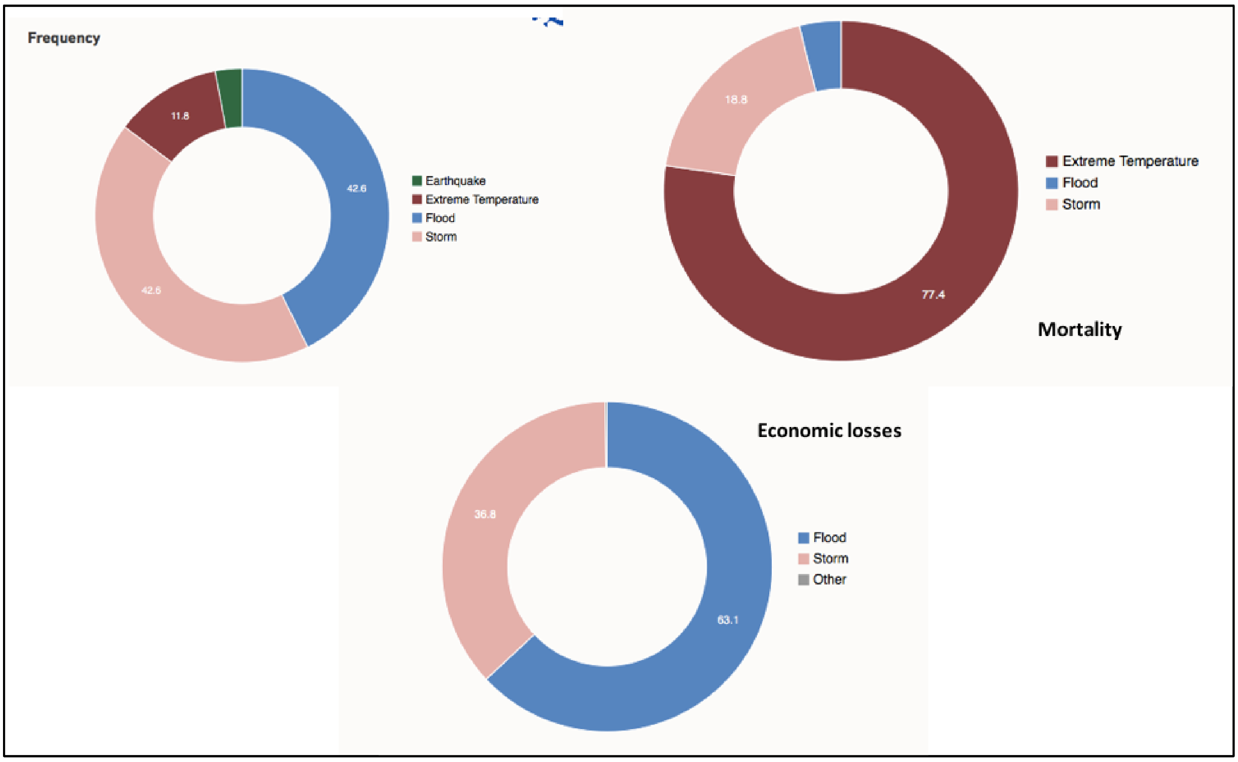
1.1.1 The Geographic Context

The United Kingdom is an island country located off the north-western coast of mainland Europe. The United Kingdom comprises the whole of the island of Great Britain which contains England, Wales and Scotland, as well as the northern portion of the island of Ireland. England, occupying most of southern Great Britain, includes the Isles of Scilly off the southwest coast and the Isle of Wight off the southern coast. Scotland, occupying northern Great Britain, includes the Orkney and Shetland islands off the northern coast and the Hebrides off the north-western coast. Wales lies west of England and includes the island of Anglesey to the northwest. Apart from the land border with the Irish Republic, the United Kingdom is surrounded by sea. To the south of England, and between the United Kingdom and France, is the English Channel. The North Sea lies to the east. To the west of Wales and northern England and to the southeast of Northern Ireland, the Irish Sea separates Great Britain from Ireland, while southwestern England, the north-western coast of Northern Ireland, and western Scotland face the Atlantic Ocean. At its widest, the United Kingdom is 300 miles (500 km) across. From the northern tip of Scotland to the southern coast of England, it is about 600 miles long (1,000 km). No part is more than 75 miles (120 km) from the sea. The capital, London, is situated on the tidal River Thames in south-eastern England (Encyclopædia Britannica, 2017).

13)

1.1.2 Disaster Profile-United Kingdom

The history of different types of disasters in the UK includes a wide variety of incidents. According to EM-DAT (2015b) during the period of 1990 to 2014, the most significant disaster events are floods and storms in terms of the frequency. In terms of mortality, 77.4% mortalities are reported due to extreme temperature and the least number of mortalities are recorded due to flood. However, as per the economic losses, floods are the most significant disaster which accounts for 63.1% of economic losses. Figure 2 describes the overall disaster losses (frequency, mortality, economic losses) during the period of 1990-2014.



The most recent major disaster event experienced was the flood of December 2015 which mostly affected northern England. It was recorded that around 17,500 properties were flooded during this period (Spencer et al., 2016).

Further, the coastline regions are usually affected by sea surges, high tides and gale force winds with severe storms and winds which can affect most of the country for at least six hours at a time. Most inland areas and regions experience storms with speeds of 55 mph and gusts which exceed 85 mph. In spite of relatively small impact, heat waves and droughts are also characteristic challenges for the UK. The impact of global warming also causes indirect effects on human health and increases the possibility of some natural disasters such as floods, rising of sea levels and so forth. Due to severe heat, the UK Government takes serious steps to prevent the elderly, young and other vulnerable population casualties through public awareness and education (Kapucu, 2009).

As can be seen, the UK is vulnerable to many natural events. Global warming, magnitude, frequency of extreme weather events and climate change scenarios have severe effects on agricultural prosperity. Severe wind storms, late spring frosts and weather conditions all have a direct impact on crop production. Being an island country affected by global climate change, the UK is a target of and destination point for severe storms and winds which cause serious damage to property. Severe windstorms can result in direct and indirect damage to buildings, vehicles, infrastructure, businesses and human life (Kapucu, 2009).

1.1.3 Disaster Management Structure

Institutions relevant for disaster management, their policies and legal backgrounds, will be discussed in Section 2, therefore, in this section, the aim is to produce a summary of the disaster management structure of the United Kingdom.

In the United Kingdom, the disaster management structure is established by an act of the United Kingdom Parliament that establishes a coherent framework for emergency planning and response, ranging from local to national level. The act is called the Civil Contingencies Act, 2004. The Civil Contingencies Secretariat is the national platform for disaster management. The Civil Contingencies Secretariat (CCS) sits within the Cabinet Office at the heart of central government. It works in partnership with government departments, the devolved administrations (Scotland, Wales & Northern Ireland) and key stakeholders, to enhance the UK's ability to prepare for, respond to and recover from emergencies. The CCS has specific objectives ranging from disaster response to building greater resilience for the future.

The overall structure of disaster management has generally remained with Central Government, fulfilling the role of co-ordinator and providing guidance. The structure of emergency management in the UK is decentralized. Most emergencies and incidents, based on scale or complexity, are handled at local level, with no involvement of Central Government. Local agencies are always the first responders and the ones who carry the burden of emergency management. In most cases, the police are considered one of the leading responders in local disasters (Secretariat Civil Contingencies, 2009).

The Climate Change Act (CCA) is the principal legislative background in dealing with climate change in the UK. The Climate Change Act produces a legislative background for both climate change adaptation and climate change mitigation. However, prior to the introduction of the Climate Change Act in 2008, there were other acts, bills and efforts initiated in the UK, focusing on climate change mitigation. Section 2.2 explains the Climate Change Act in detail.

1.2 Legal/Policy and Science Approaches in relation to DRR

This section provides a brief description of the existing legal/policy and science approaches related to CCA and DRR in the context of the United Kingdom. A critical argument on the missing links, gaps and challenges is provided in Section 4.

1.2.1 Legal/Policy Approaches in Relation to DRR

1.2.1.1 *Civil Contingencies Secretariat and Civil Contingencies Act, 2004*

UNISDR (2013b) explains the establishment of the Civil Contingencies Secretariat. Accordingly, it was established in July 2001 after serious flooding, the Fuel Crisis in 2000 and the Foot-and-Mouth Disease outbreak in 2001, exposed deficiencies in the UK's civil protection arrangements. Since then, the CCS has worked to improve the UK's preparedness for, and response to, emergencies.

The Civil Contingencies Secretariat (CCS) sits within the Cabinet Office at the heart of Central Government. It works in partnership with government departments, the devolved administrations (Scotland, Wales & Northern Ireland) and key stakeholders to enhance the UK's ability to prepare for, respond to and recover from emergencies.

The CCS has specific objectives which range from emergency response to building greater resilience for the future. The CCS's specific objectives are:

1. Spotting trouble, assessing its nature and providing warning:

Emergencies in the early years of this century showed that the UK was missing the warning signs, failing to prevent emergencies and being caught unaware when they occurred. The CCS now works with a range of organizations to deliver a forward look, which helps to identify and prevent potential emergencies.

2. Being ready to respond:

This objective covers the preparedness of all those who might have a role to play in the response to a major disruptive challenge. As well as ensuring that the CCS itself is ready, it is also about tracking the preparedness of organizations at national and local levels, in the public sector and outside, and using the Civil Contingencies Act to develop and embed performance audit and management regimes across all responders, rooted in formal preparedness assessments. The CCS also aims to ensure mechanisms are in place so that the UK is as well placed as it can be to respond to threats which horizon-scanning shows may be at higher risk of occurring.

3. Building greater resilience for the future:

This objective covers action at all levels, from local to international, to build stronger resilience capabilities. It thus covers the processes led by the CCS to drive the delivery of resilience capabilities. It also covers international work to develop closer relations in the resilience field through which we can build mutual resilience. This includes bilateral work and action in the EU and in NATO to seek to build greater resilience capability in partner countries, as well as the EU's own ability to manage a crisis.

4. Providing leadership and guidance to the resilience community:

The CCS aims to tell those involved in delivering and building resilience across the UK what the Secretariat is trying to do, where it is trying to get to, how it will get there and how it will know that it has succeeded - in short, to build consistency and coherence across the UK. Some key means are already in place, especially via the Capabilities Programme and its outputs and the Civil Contingencies Act. The CCS will be focusing on the development of a 'National Resilience Strategy' and reviewing the national exercise programme.

5. Effective management:

This objective covers the way in which the CCS manages itself and its effective management of Cabinet Office processes. Some of it is routine, but nonetheless, important. The CCS aims to sustain its reputation as effective managers of people and money, and as efficient operators of Cabinet Office processes.

The Cabinet Office Civil Contingencies Secretariat (2004) explains that the establishment of the Civil Contingencies Act, 2004, is one of the most significant achievements of the CCS. The Civil Contingencies Act is an act of the United Kingdom Parliament which establishes a coherent framework for emergency planning and response, ranging from local to national level. It also replaces the former Civil Defence and Emergency Powers legislation of the 20th Century.

The Act, and accompanying regulations and non-legislative measures, delivers a single framework for civil protection in the United Kingdom capable of meeting the challenges of the 21st Century. The Act is separated into two substantive parts:

Part 1:

This focuses on local arrangements for civil protection, establishing a statutory framework of roles and responsibilities for local responders. The Act divides local responders into two categories, depending on the extent of their involvement in civil protection work, and places a proportionate set of duties on each.

Category 1 responders are those organisations at the core of emergency response (e.g. emergency services, local authorities). Category 1 responders are subject to the full set of civil protection duties. They are required to:

- Assess the risk of emergencies occurring and use this to inform contingency planning.
- Put in place emergency plans.
- Put in place Business Continuity Management arrangements.
- Put in place arrangements to make information available to the public about civil protection matters and maintain arrangements to warn, inform and advise the public in the event of an emergency.

• Share information with other local responders to enhance co-ordination.
• Co-operate with other local responders to enhance co-ordination and efficiency.
• Provide advice and assistance to businesses and voluntary organisations about Business Continuity Management (Local Authorities only).

Category 2 organisations (e.g. Health and Safety Executive, transport and utility companies) are 'co-operating bodies' who, while less likely to be involved in the heart of planning work, will be heavily involved in incidents that affect their sector. Category 2 responders have fewer duties: co-operating and sharing relevant information with other Category 1 and 2 responders.

Part 2:

This focuses on emergency powers, establishing a modern framework for the use of special legislative measures that might be necessary to deal with the effects of the most serious emergencies. In the UK, emergency powers allow the making of special, temporary legislation to deal with the most serious of emergencies. They are not a means for instigating martial law, for undermining Parliament, banning political parties or anything else of that nature. An essential point to note is that emergency powers legislation is a mechanism for dealing with only the most serious of emergencies that require an urgent response: an instrument of last resort. The Act introduces a range of new features, mostly designed to ensure emergency powers cannot be misused and can be used in a more targeted and proportionate manner.

1.2.1.2 *The Flood and Water Management Act, 2010*

As a major, legislative step towards improving both flood risk management and the way to manage water resources in the United Kingdom, the Flood and Water Management Act, 2010, was introduced. It seeks to define clearer roles, responsibilities and standards for the creation of sustainable drainage. Whilst the Act places primary responsibility for managing new regulations on Local Authorities, responsibility for the specification, design, implementation and maintenance of sustainable urban drainage systems (SUDS) schemes remains shared between local government, developers, land-owners and even home-owners.

The Flood and Water Management Act, 2010, encourages the use of sustainable drainage in new developments and re-developments. It does this by requiring drainage systems to be approved against a set of National Standards. Approval is required before building can commence and a connection to the sewer can be allowed. It also makes Local Authorities responsible for adopting and maintaining SUDS.

Approval of Drainage Plans

Plans for new drainage systems would need to be approved before construction could start by the SUDS Approving Body (SAB), which will be the unitary or county council for the area. Without the Approving Body's consent, no construction work can commence on a project. The aim is to encourage pre-application discussions between developers, planners, highways authorities and the SAB, in order to avoid delays to the approval system. SUDS will become a routine feature of new construction and pre-application discussions will compel stakeholders to consider SUDS at the earliest stages of site design in order to maximise their use on the development and ensure a smooth approval process. Where both planning permission and SUDS approval are required, the processes will run together. Applications for the drainage system and for planning permission can be submitted together. The planning authority will notify the developer of the outcome of both the planning permission and drainage approval at the same time, including any conditions of approval.

New Responsibilities for Local Authorities

The Flood and Water Management Act, 2010, compels local authorities to take responsibility for leading the co-ordination of flood risk management in their areas and does this by creating the new role of the 'lead local flood authority'.

The Act defines the lead local flood authority for an area as the unitary authority or the county council. This makes clear who is responsible for managing flood risks, but does not prevent partnership arrangements to make full use of all available capabilities and experience. The Act requires a lead local flood authority to develop, maintain, apply and monitor a strategy for local flood risk management in its area. The lead local flood authority will be responsible for ensuring the strategy is put in place, but partners can help them develop it in the way that suits them best. Local flood risk includes surface run-off, groundwater and watercourses (including lakes and ponds). In developing their flood risk strategy, local authorities must consider the full range of measures possible, consistent with a risk management approach. A Local Surface Water Management Plan should provide the basis for managing local flood risk.

Source - Flood and Water Management Act (2010)

1.2.1.3 *Local Government and Housing Act, 1989 (revised 2011)-Provision 156 for Disaster Risk Reduction*

This is an act to provide for a national code of local government conduct and to make provision for certain existing grants and financial assistance and planning by local authorities in respect of emergencies. Specific disaster risk reduction provisions are included in Section 156 of this act. Section 156 provides provisions to undertake contingency planning to deal with a possible emergency or disaster if it involves destruction of, or danger to, life or property, and if it is likely to affect the whole, or part, of their area.

Source - Local Government and Housing Act revised 2011 (1989)

1.2.1.4 *United Kingdom-Emergency Powers Act (revised 2005)*

This act contains the Government's generic emergency powers legislation in Section 2. It is implied that there must be no expectation that the Government will agree to use emergency powers, and that planning and response arrangements must assume that they will not be used. Section 1 was repealed by the Civil Contingencies Act, 2004 (Preventionweb, 2005).

1.2.1.5 *Flood Risk Regulations, 2009*

Flood risk management planning is important. Flood risk regulations, 2009, set out where and how to manage flooding so that communities and the environment benefit the most. Flood risk management planning is integral to the way risk management authorities (RMAs) work: it allows authorities to develop a shared understanding of risk from all sources of flooding and agree priorities with communities to manage that risk.

The European Floods Directive has formalised flood risk management planning. The Flood Risk Regulations, 2009, implement the directive and require Lead Local Flood Authorities (LLFAs), the Environment Agency and Natural Resources Wales to prepare and publish Flood Risk Management Plans (FRMPs) on a six-year cycle.

1. The Environment Agency must prepare, in relation to each river basin district:(a) A preliminary assessment map.
(b) A preliminary assessment report in relation to flooding from-
  (i) the sea
  (ii)main rivers
  (iii)reservoirs

2. A Lead Local Flood Authority must prepare a preliminary assessment report in relation to flooding in its area. Similarly, the Environment Agency must prepare a flood risk management plan in relation to each flood risk area identified by it under Regulation 13. A Lead Local Flood Authority must prepare a flood risk management plan in relation to each relevant flood risk area.

Source - The Flood Risk Regulations (2009)

1.2.2 Science Approaches in relation to DRR

1.2.2.1 *UK Government Office for Science - Reducing Risks of Future Disasters*

The aim of this government initiative has been to provide advice to decision makers on how science can inform the difficult choices and priorities for investing in disaster risk reduction (DRR), so that the diverse impacts of future disasters can be effectively reduced, both around the time of the events, and in the longer term. This work has drawn upon the latest developments in natural and social science, and lessons from past and ongoing DRR initiatives.

This work offers a strategic overview of the present and future potential of science to inform and enhance DRR over the next three decades. It considers disasters whose primary causes are natural hazards. Its focus is on disasters that occur in developing countries but lessons from past disasters in developed countries are also drawn upon. It explores the diversity of impacts and the extent to which these are, or should be, considered by decision makers but does not review in detail the scale of past and present disasters. Based on scientific initiatives, this work suggests the range of current and future impacts that can result from disasters with particular emphasis being given to mortality and morbidity, as well as direct and indirect economic impacts. The underlying drivers that will influence how these impacts could evolve in the future, and how changes in exposure and vulnerability will drive changes in the direction and magnitude of future disaster risk, are explored.

Further, the process by which risk forecasts are produced, and how this might evolve in the future, are discussed. The role of probabilistic forecasts, practical steps required for mapping and modelling vulnerability and exposure, issues related to data collection and management, and building models to forecast changes in future disaster risk are also considered in this government initiative. In addition to the above, the options for responding to risk forecasts are explored. Specific measures identified include the use of financial instruments (transferring risk), investment in early warning systems (avoiding risk), designing resilient infrastructure and restoring ecosystems (reducing risk). The decision-making process is central to the risk response, and the tools that can help with decision-making under uncertainty, including cost-benefit analysis, are discussed. Finally, the case for systematic evaluation of effectiveness is made.

Source - The Use of Science in Humanitarian Emergencies and Disasters (2012)

1.2.2.2 *The Use of Science in Humanitarian Emergencies and Disasters*

In March 2011, Lord Ashdown presented his Humanitarian Emergency Response Review to the Government. In his report, he provided a comprehensive assessment of the UK and the international community's current response to humanitarian emergencies. Lord Ashdown found that the Department for International Development (DFID) is well respected and well regarded. However, the review also concluded that, in light of the potential future need, there would have to be a step change in the way DFID responded and in the way that science is used in that response.

This report has constrained its scope to disaster risks and uncertainties arising from natural hazards such as earthquakes, tsunamis, storms, heat waves and wildfires, floods and drought, as well as biological rapid onset disasters such as epidemics or pandemics of human, animal or plant diseases (The Use of Science in Humanitarian Emergencies and Disasters, 2012).

The report considers:

- What processes are currently in place for providing advice and how effective they are.
- How well advice is used at present and therefore, what is currently achieved.
- What policy and operational gaps there are nationally and internationally.
- What is missing from current advice to meet the policy and operational needs.
- How better use can be made of current advice and whether new mechanisms and links are needed in a UK or international context.
- Whether there is a need for a formal advisory arrangement such as a Scientific Advisory Group.
- What formal arrangements, similar to those adopted to provide UK emergency advice, would improve the UK Government's operational response to international emergencies.
- What explicit links exist in UK, non-government agency activities.

This report is primarily focused on government, and changes to the way government plans and prepares for international humanitarian emergencies and disasters, including better use of science and knowledge. It discusses how global risk assessments can be used to inform policy makers, and describes several, effective early warning systems for both rapid and slow onset disasters.

It also presents the UK Natural Hazards Partnership, which has been established to provide information, research and analysis on natural hazards for the development of more effective policies, communications and services for the Government. One of the roles of the Partnership is to provide scientific and technical advice to the Cabinet Office on matters relating to natural hazard risks for the National Risk Assessment (NRA). The report presents six recommendations to UK Government, where immediate changes can be made to help and support the use and uptake of science for the benefit of disaster risk reduction (Preventionweb, 2012).

1.3 Legal/Policy and Science Approaches in relation to CCA

1.3.1 Legal/Policy Approaches in Relation to CCA

The UK faces climate change impacts, specifically, threats of flooding and extreme temperature. Accordingly, the Government of the UK has taken early steps to introduce both mitigation and adaptation policies to face the impacts of climate change (Bowen and Rydge, 2011).

As introduced in Section 1.1.3, the Climate Change Act (CCA) is the principal legislative vehicle in dealing with climate change in the UK. The Climate Change Act produces the legislative background for both climate change adaptation and climate change mitigation. However, prior to introducing the Climate Change Act in 2008, there were some other acts, bills and efforts initiated in the UK, focusing on climate change mitigation. Therefore, it is better to have a brief idea of these before reviewing the existing policies on climate change adaptation. The following are some of the major acts and bills applicable to climate change mitigation in the UK.

- Non-Fossil Fuel Obligation (NFFO) was introduced as a part of the Electricity Act in 1989, to generate both nuclear electricity and renewable energy in the energy sector as a mitigation strategy.

- The UK further introduced the Climate Change Programme in 2000, aiming to reduce GHG emission as a mitigation strategy. This programme was updated in 2006, with a target of reducing CO_2 levels to 15-18% by 2010 compared to the 1990 level, and further, to reduce overall GHG emission by 23-25%.
- Another important step taken by the Government of the UK was the imposition of the Climate Change Levy in 2001, replacing the Fossil Fuel Levy (FFL), (Vaux et al.). Accordingly, energy-intensive firms benefit from up to 80% discount by joining the Climate Change Agreement (CCA), which agrees to achieve energy efficiency or carbon-saving targets. The Renewable Obligation (RO) was introduced as the primary renewable energy policy instrument in 2001. Further, the Energy Efficiency Committee (EEC) was set up in 2002 with a target of achieving 1% domestic energy emission reduction by 2005. This was aimed at saving 62TWh energy within Phase One in 2005, and a saving of 130TWh during Phase Two in 2005-2008.
- In the year 2010, both Feed-In-Tariffs and the Carbon Capture and Storage Demonstration Project were introduced by the UK (Bowen and Rydge, 2011). The Carbon Plan, introduced in 2011, aimed to reduce carbon emissions following a vision, plan and specific time periods for achieving the desired levels by government departments. The Feed-In-Tariffs encourage small-scale, low carbon electricity generation in the UK and as a result, over 470,000 installations were registered by 2013 (Department of Energy and Climate Change, 2013). Among the programmes introduced in 2012, the Energy Bill (EB) and Renewable Heat Incentive (Turner Monique Mitchell and Underhill Jill Cornelius) are prominent. The Energy Bill was passed by Parliament to approve the Green Deal policy which allocates loans for energy saving measures so that consumers may purchase energy efficient improvements for their properties.

The Department for Energy and Climate Change (DECC) takes the lead role in the UK's policy on emission reduction whereas, the Department for Environment, Food and Rural Affairs (DEFRA) deals with the UK's climate change adaptation policy. In addition, the devolved administrations in Scotland, Northern Ireland and Wales, work towards emission reductions with their own targets and programmes. For example, the Climate Change (Scotland) Act was passed in 2009, committed to a 42% reduction of emissions by 2020.

Source - Department of Energy and Climate Change (2013).

1.3.1.1 *Climate Change Act, 2008*

The major climate change adaptation effort of the UK was the introduction of the Climate Change Act in 2008. The Act provides the legislative framework for both climate change adaptation and mitigation. The Act is considered as the world's first, long-term, legally binding framework to address climate change, in accordance with the Kyoto Protocol (Sustainable Development Unit, 2017). The Act was introduced following a bill presented to Parliament in 2007 and was effective from 26th November 2008. The Act states the requirements for adaptation through Climate Change Risk Assessment (CCRA), the National Adaptation Programme (NAP) and the Adaptation Reporting Power (ARP). The Committee of Climate Change (CCC) and the Adaptation Sub Committee (ASC) advise the Government of the UK and devolved administrations on adaptation strategies (Chartered Institute of Water and Environmental Management, 2015).

Further, the Act established legally binding targets to reduce GHGs by 80% by 2050 and specifically to reduce CO_2 emissions by 26% by 2020 against a 1990 baseline. Similarly, it introduced a carbon budgetary system, starting from 2009, as a five-year budget system to cap the GHG emission levels. The United Nations Framework-Convention on Climate Change (UNFCCC) was established with the view of advising the Government on carbon budgets and to ensure accountability and transparency of the efforts by submitting a report to Parliament. It further agrees to include the level of emissions from international aviation and shipping by 2012. Similarly, the Act further explains the responsibility of the National Adaptation Strategy (NAS) which is to assess the UK's risk of Climate Change and prepare strategies accordingly. The Act makes provisions for financial allocations on domestic waste management through reduction of waste generation, recycling of waste and collection of household waste. In addition, the Act introduced a charge for single use carrier bags.

1.3.1.2 *The National Adaptation Strategy (NAS) and the National Adaptation Programme (NAP) to Climate Change - UK*

As described in Section 2.2.1.1, the Climate Change Act, 2008, has provisions to establish the National Adaptation Strategy to Climate Change. The Nation Adaptation Strategy aims to provide a coherent and co-ordinated approach to adaptation for the UK. The key drivers for introducing the UK's Climate Change Adaptation Policy are related to:

a.) Weather events, for example: flood management, water resources, coastal erosion, extreme temperatures, biodiversity conservation.

b.) General risk assessments, for example: availability of climate information and adaptation tools within the UK.

c.) The Government's policy initiatives, for example: climate change mitigation policies, UNFCCC, Sustainable Development Goals.

d.) Financial drivers are the economic factors, insurance.

e.) Political will towards adaptation, for example: the Government of the UK has displayed consensus and leadership on the importance of climate change and the need for adaptation.

The NAS was developed in the process of:

1. The establishment of the UK Climate Impacts Programme (UKCIP) in 1997, with the aim of co-ordinating impact research in the UK. UKCIP has played a major role in increasing awareness of the need to adapt and in driving forward action on the ground.

2. The UK Climate Change Programme (CCP:2000, updated 2006) set out the Government's intention to develop a "comprehensive and robust approach to adaptation in the UK" through an Adaptation Policy Framework.

3. The publication of the Consultation over the Adaptation Policy Framework (DEFRA, 2005). This effort was able to gather views on whether stakeholders thought a NAS would be a useful and necessary tool and information regarding climate change adaptation activities across the UK.

4. Introduction of the adaptation provisions within the Climate Change Bill (DEFRA, 2008). The Bill sets

out a statutory framework for legislation in the UK. This further requires the Government to develop a statutory adaptation programme to address the risks identified in a national climate change risk assessment.

The first National Adaptation programme was introduced in 2013. The National Adaptation Programme covers twenty-four focus areas across six main themes: the built environment, infrastructure, healthy and resilient communities, agriculture and forestry, the natural environment and business, with a separate chapter on local government. The Government of the UK is developing its 25 year Environment Plan which shows the Government's climate change adaptation strategies which are embedded in their plans and investments (HM Government, 2017). The NAP has identified: built environment, infrastructure, the health and social care sector, agriculture and forestry, natural environment, business and local government as the most vulnerable sectors to climate change. For each sector, the NAP identified the possible risk from climate change and proposed activities under each focus area to minimize the risk of climate change. For example: within the built environment, the risk of floods, extreme temperature and water efficiency are identified as climate change threats. Accordingly, investment in flood risk management, establishment of the National Flood Forum, management of surface water flood risk, spatial planning and activities ensuring that homes and communities are more resilient were introduced.

Source - HM Government (2013).

As DEFRA (2017) details, the First National Adaptation Programme, introduced in 2013, has implemented the following actions in the UK:

- Investing £2.5 billion over six years to improve flood defences and to protect over 300,000 homes.
- Updating the Heatwave Plan for England to protect the population from heat-related harm to health.
- Strengthening planning policy to make clear that sustainable drainage systems should be included in all major, new developments, unless demonstrated to be inappropriate.
- Maintaining over 95% (by area) of England's Sites of Special Scientific Interest (SSSIs) at 'favourable' or 'recovering' condition, and establishing 50 Marine Conservation Zones with 34 new bylaws to protect them.
- Working closely with the food industry to ensure the security and resilience of food supply, using the latest technology delivered through the new Agri-Tech Innovation Centres.
- Constructing a UK Plant Health Risk Register to compare the risks posed by different plant pests and pathogens.
- Committing to develop a 25-year environment plan that takes climate change into account (DEFRA, 2017).

1.3.1.3 *Climate Change Risk Assessment (CCRA)*

Under the provisions of the Climate Change Act, 2008, the UK Government is required to publish a UK-wide Climate Change Risk Assessment (CCRA) every five years. The Act stipulates that the Government must assess, "the risks for the United Kingdom from the current and predicted impacts of climate change" (Committee on Climate Change, 2017).

The CCRA intends to compare and prioritize the climate change risks over the next 80 years and provide support to the Government and other organizations in making decisions on adaptation policies and actions. Major risks of climate change are: flood risk, extreme temperature events, water resources and ecosystems. The benefits arising from climate change in the UK are the possible reduction in the number of deaths due to less harsh winters and longer-time availability for growing crops (Chartered Institute of Water and Environmental Management, 2015).

According to the latest climate change risk assessment, completed in 2017, the greatest direct climate change-related threats for the UK are large increases in flood risk and exposure to high temperatures and heatwaves, shortages in water, substantial risks to UK wildlife and natural ecosystems, risks to domestic and international food production and trade, and from new and emerging pests and diseases. A warmer atmosphere can hold more moisture, leading to heavier rainfall and more frequent flooding, including outside of recognised flood risk areas. Higher temperatures will affect public health, infrastructure, business, farming, forestry and the natural environment. Dry periods, when combined with higher temperatures, are likely to result in more severe and prolonged droughts. Projected sea level rises of 50-100 centimetres by 2100 will exacerbate flood risks and accelerate the process of coastal change for exposed communities.

Source - Committee on Climate Change (2017).

1.3.1.4 ***Adaptation Reporting Power (ARP)***

The Climate Change Act, 2008, outlines the powers of the Secretary of State for asking statutory organizations to produce a report on their adaptation options. According to the Adaptation Reporting Power, statutory organizations are required to prepare reports on the impact of climate change and their proposals for adaptation (Chartered Institute of Water and Environmental Management, 2015). 90 organisations have produced reports in the first round. This is applicable to organizations that are responsible for essential services and infrastructure and it is required to make sure that they have an adaptation strategy as part of their risk management process.

The aims of the ARP are: to ensure climate change risk management is systematically undertaken by reporting authorities; to help ensure public services and infrastructure are resilient to climate change and to monitor the level of preparedness of key sectors to climate change. ARP engages directly and indirectly with public organizations through raising awareness, capacity building and provisioning of good examples of effective practices.

Section 2.2.1 discussed the existing legal/policy approaches in relation to climate change adaptation and Section 2.2.2 will discuss the existing science approaches in relation to CCA.

1.3.2 **Science Approaches in relation to CCA**

1.3.2.1 ***United Kingdom Climate Impact Programme (UKCIP)***

Climate change appeared on the agenda of the UK Government after the talk by the Prime Minister, Margaret Thatcher, to the Royal Society in 1980 and the establishment of the Hadley Centre which published two reports on the impact of climate change in the UK in the mid-1990s. The Hadley Centre for Climate Prediction and Research was a research institution which came into existence in 1990, housed within the UK Met Office. A large proportion of the Hadley Centre's budget came direct from Government via the then Department of Environment. The first of the two reports on the impact of climate change was published following the IPCC's first assessment report in 1990. This report was named as the first national assessment of the possible impacts of climate change for the UK. This report is also known as the Climate Change Impacts Review Group (CCIRG 1991) report. The second CCIRG report was published in 1996 (CCIRG 1996), timed to coincide closely with the release of the second assessment report of the IPCC (Hulme and Turnpenny, 2004).

The climate change adaptation mission was then started after the establishment of the UKCIP in 1997. The UK climate change policy making processes were influenced by the Royal Commission on Environmental Pollution, UKCIP, the Hadley Centre and the Committee on Climate Change. Some argue that the UK climate change policy is inspired by expert opinions (Lorenz et al., 2015) whereas others argue that it has been influenced by geopolitical factors (Owens, 2010).

At the establishment of the UKCIP, its objectives were limited to identify the climate risks within the UK. The UK Government was interested in understanding the impact of climate change within the UK. Hence, they established the UKCIP to fulfil the requirements which were undertaken by national assessments conducted by the Climate Change Impacts Review Group in 1991 and 1996. Later, its objectives were broadened to decision-making for adaptation, exchanging knowledge and ideas and creating adaptation strategies. UKCIP works with scientific research, policy making and adaptation practices by bringing a wider range of stakeholders together working in climate change. They provide consultancy services, conduct research and establish partnerships. They are interested in working with multi-stakeholders when developing adaptation strategies (UKCIP, 2011).

1.3.2.2 ***UKCP09***

The UK has produced climate scenarios/projections since 1980. Apart from earlier climate change scenarios of CCIRG91 and CCIRG96 (Hulme and Dessai, 2008), the present UK Government is working with probabilistic UKCP09 climate scenarios (Tompkins et al., 2010). However, those early projections are aimed at the research community and the policymakers. With the establishment of the UKCIP, UKCP98 and UKCP02 targeted a broader set of stakeholders: infrastructure operators, public bodies, consultants, regulators, private utility companies and industry associations. Compared to other countries, the UK engages in significant levels of climate change research.

The aim of the UKCP09 is to provide projections of climate change for decision-making purposes, specifically at local level. These projections are defined for specific, identified events (Frigg et al., 2015).

Scientific knowledge and expertise provides key inputs in policy making (Braun and Kropp, 2010, Kropp and Wagner, 2010). Since the White Paper in 1999 for Modernizing Government, introduced in the UK, the use of scientific information for policy making has come to the forefront (Tang and Dessai, 2012). The UK Government invested significantly to improve its evidence-based, policy making system. Among these priority policy making areas, climate change adaptation has gained significant traction, apart from climate change mitigation, in the UK, as a result of establishing the Climate Impact Programme (UKCIP) in 1997 (Hedger et al., 2006). This has been further increased with the establishment of the Climate Change Act in 2008 (Tang and Dessai, 2012).

More specifically, the Climate Change Act requires a UK-wide climate change risk assessment every five years. This is to understand climate change risks in the UK and develop a National Adaptation Programme.

Even though projections are used in national and international policy making, they are based on considered scenarios. The first scenarios in the UK were published in 1991 and evolved until the latest projection of UKCP09 developed by a consortium of Defra, UKCIP and the Met Office. This provides projections of climate change when compared to a 1961-90 baseline. The UKCP09 provides information relating to land projections, marine and coastal projections, observed trends in climate data, a weather generator, an 11-member regional climate model output ensemble and spatially coherent projections in the UK. The new UKCP09 is superior to other previous projections since it quantifies uncertainties explicitly in a probabilistic way. Further, it provides specialized climate information for administrative regions, river basins and marine regions as well. They also encourage participation of a range of inputs for decision-making (Tang and Dessai, 2012).

The UK Climate Change Risk Assessment has been identified as an example of interactions between politics and evidence-based policy making (Tangney, 2016). The Government of the UK has introduced and invested in policy focused science through introducing UKCP09 and CCRA and some knowledge brokerage, for example, UKCIP, the Environment Agency's Climate Ready Programme and the regional climate partnerships (Porter et al., 2015).

Section 2 described the existing legal/policy and science approaches in relation to climate change adaptation and disaster risk reduction. Section 3 details the methodology of the study. It includes a brief outline of the ESPREssO project, the key challenges which ESPREssO seeks to address and the details of the methods used for the study.

2 Research Methodology

2.1 About ESPREssO

ESPREssO (Enhancing Synergies for Disaster Prevention in the European Union) aims at contributing to a new, strategic vision on how we can approach risk reduction and climate change adaptation, thereby opening new frontiers for research and policy making.

To achieve this goal, the project addresses three main challenges:

1. To propose ways to create more coherent national and European approaches to disaster risk reduction, climate change adaptation and resilience strengthening.

2. To enhance risk management capabilities by bridging the gap between science and legal/policy issues at local and national levels in six European countries.

3. To address the issue of efficient management of trans-boundary crises.

Accordingly, ESPREssO undertook a comprehensive and scientific research methodology to review the existing, legal/policy and science approaches in relation to the three ESPREssO challenges as stated above. A brief outline of the three ESPREssO challenges are as follows:

2.1.1 Climate Change Adaptation vs Disaster Risk Reduction

The links between Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) have become increasingly clear as climate change has increased the occurrence of damaging, extreme weather events. The number of weather-related disasters has increased in recent decades (Guha-Sapir et al., 2012). In the context of climate change and extreme events, adaptation is the key countermeasure, whereas DRR often remains a peripheral topic (Birkmann and von Teichman, 2010). Thus, the gap between CCA and DRR efforts remains wide open, institutionally, conceptually and in terms of research organisation (Thomalla et al., 2006) and the external politics of the EU (Schipper and Pelling, 2006).

Today, research is about approaching disasters in the framework of the CCA. DRR and CCA seem to remain isolated from each other (Gaillard, 2010). While the interdependencies are evident (Becker, 2009), it is still not entirely clear how to achieve CCA outcomes through improved disaster management policies, planning and risk management. In the last decade, attention was paid to the need for a greater discussion on the issue of disaster governance (Tierney 2012; UNDP 2010; van Asselt & Renn, 2011) and resilience (Cannon & Müller-Mahn, 2010). It seems that these concepts offer an opportunity for the integration of CCA and DRR.

2.1.2 Science vs Legal/Policy Issues in DRR

Scientific capabilities and institutional capacities to approach disaster management have not proceeded at the same speed up to now. Science has developed innovative concepts and tools that institutional capacities can hardly use under the current legislative framework. Typical examples are the resistance to widespread use of early warning and multi-risk methods. The relation between knowledge production and institutional responses is crucial to manage modern, increasingly complex disasters. The definition of the role, tasks and responsibility allocation and distribution between scientists and practitioners is a topic that deserves more attention. In their role as advisers, scientists have emerged as a form of the fifth branch of government. However, even though the growing dependence of regulatory agencies on scientific and technical information has granted scientists a greater influence on public policy, opinions differ as to how those contributions should be balanced against other policy concerns (Jasanoff, 2011, Jasanoff, 2009).

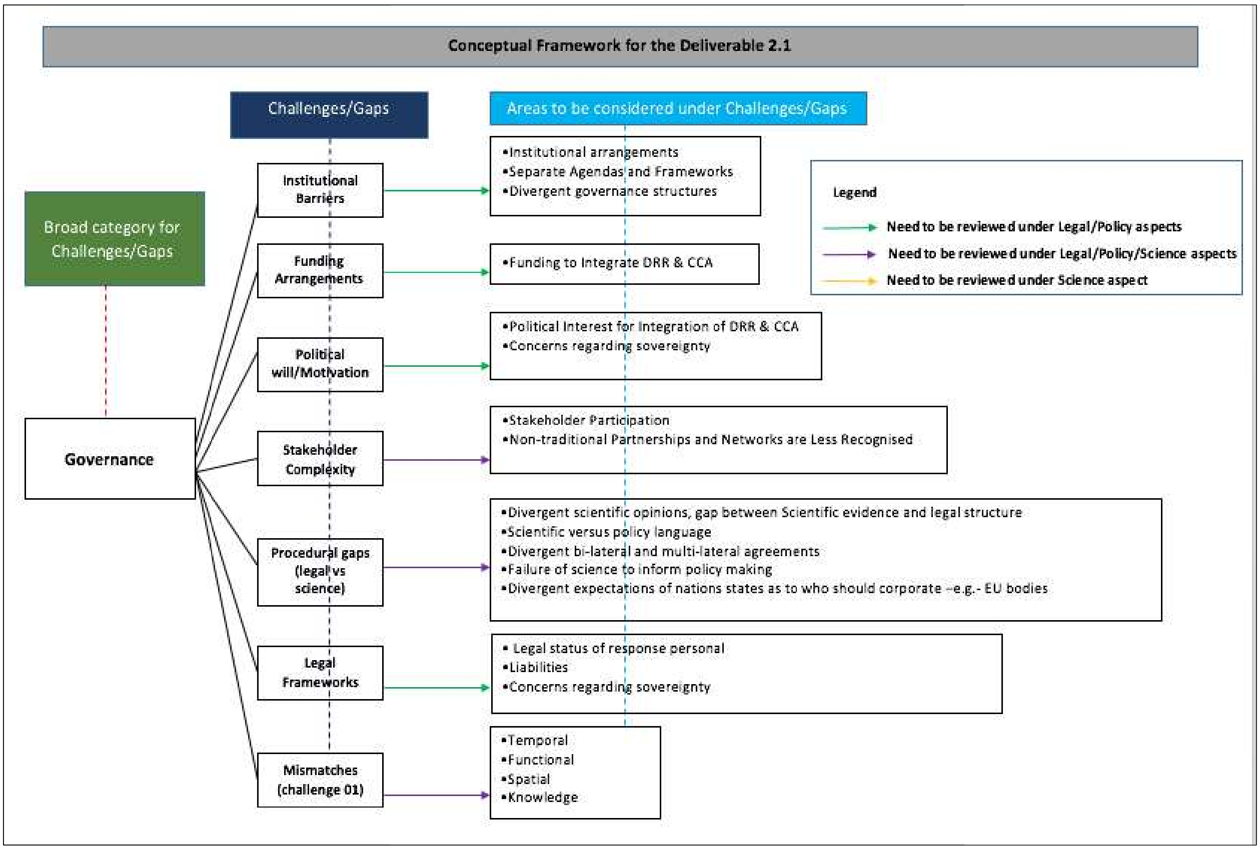
2.1.3 National Regulations for the Preparation to Trans-Boundary Crises

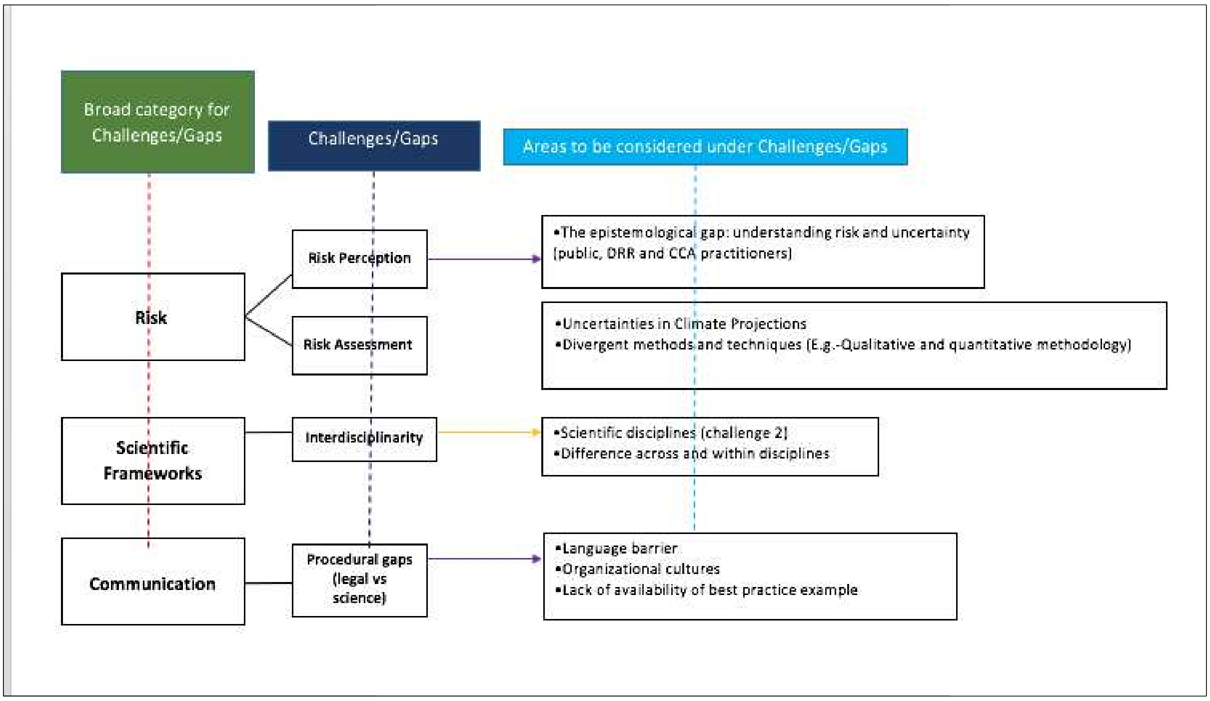
Frequently, disasters have cross-boundary impacts. Recent examples are the Aila Cyclone that affected India and Bangladesh in 2008, and the Kashmir earthquake in 2005 that affected both India and Pakistan. Recent European cases include the Central Europe flood, affecting Eastern Germany and Hungary, the extreme drought and heat wave that hit several countries in Europe in 2003 and caused the destruction of large areas by fires, and the earthquake that hit the borders between Italy and France in 1995. Experience shows that although there is a general tendency to co-operate, as the number of stakeholders increases, so too does the competition among them, while different regulations can hinder the organisation of an effective response. In fact, the large and increasing number of public and private actors is one of the major complexities in disaster response and risk management (Granot, 1997, Schneider, 1992, Kory, 1998, Katoch, 2006). The increase in the number of stakeholders and the change in stakeholder backgrounds have, arguably, important repercussions on efficient actions in disaster settings (Telford and Cosgrave, 2007). As Quarentelli points out, "Government and private groups may have different interests, tasks and goals," (Quarentelli, 1997:48). However, whilst there seems to be general consensus about the growing number of actors, there is a surprising lack of in-depth analysis of the consequences and of the actual impact that so many actors have on the way humanitarian action is handled.

2.2 Research Methods used for the Study

The aim of this study was to review the existing, legal/policy and science approaches in relation to the three ESPREssO challenges as described in Section 3.1.

At the initial stage, a literature review was conducted to identify the key challenges and gaps related to the three, key ESPREssO challenges. Thereafter, based on the initial findings, a conceptual framework (figures 3 & 4) was developed which led to identifying the key themes for the study. Once the key themes were finalised, the data collection instruments and the reporting template for the national report were identified.





The key data collection instruments are the desk-based literature review and semi-structured, expert interviews. The desk-based study had two purposes. The first was to identify the legal/policy and science approaches available in the country. Secondly, the desk-based literature review identified the existing issues and critically reviewed the legal, policy and science approaches. The desk-based literature review was the ideal data collection method to initiate the study. As stated above, one of the objectives of the study was to identify the legal/policy and science approaches available in the country. In order to identify already available legal/policy and science approaches, the best tool was the desk-based literature review.

Semi-structured, expert interviews and focus group expert discussions were identified as the best tools for primary data collection. However, considering the difficulty in gathering experts to a single venue at one time during this limited study period, it was decided to go ahead with the expert interviews. Since this is a review of legal/policy and science approaches, it was not vital to interview the community for this study. Community engagement is a well-known tool and a strategy for data collection but, individuals may not have expert knowledge on the existing laws/polices or frameworks. Community engagement would have been ideal if the study meant to review the existing disaster risk in the neighbourhood or village. For interviews, it was necessary to select experts from both CCA and DRR and from different types of institutions.

The project team aimed to conduct comprehensive interviews with at least 10 experts. Accordingly, around 40 email invitations were sent to potential experts, keeping in mind the response rate for an interview may be 25%. However, the project team received a 37.5% response rate for interview invitations and accordingly, 15 interviews were conducted with disaster resilience and climate change adaptation experts in the UK. The sample represented academics, practitioners, NGOs, representatives from government bodies and so forth.

Once the data were collected, they were qualitatively analysed by using QSR-NVivo version 11 and thereafter, based on the identified key themes, mind maps were developed to understand the context for each and every issue and to identify the influence of the existing legal/policy and science approaches. The figure below demonstrates the node structure of the NVivo analysis:

Funding Arrangements	7	31
Funding sources, alloc...	7	19
Policies legal backgrou...	6	12
Information Management	8	50
dissermination of best...	3	5
Language or communi...	8	40
Academic & practiti...	6	13
Communication CC...	7	13
Practitioners & gene...	7	13
working with nation...	0	0
Support of legal-policy...	4	5
Institutional Arrangements	9	36
Challenges in the exsis...	9	20
Divergent government...	5	9
Need for Integration	4	7
Interdisciplinarity	0	0
Mismatches	7	23
Competition between...	6	16
influence-support mad...	0	0
Lega-policy promote c...	3	3
Spatial-functional-tem...	3	4
ways spatial-functional...	0	0
Political will-Motivation	6	20
existing legal-policy ba...	4	5
Identified issues in the...	2	2
Political will to integrate	4	5
Political will to tackle tr...	4	8
Procedural gaps and lega...	5	6
Risk Assessment	3	5
Challenges faced by C...	3	4
legal-policy influence t...	1	1
Risk Perception	7	16
Legal-policy framewor...	3	3
Perceiving risk	7	13
Stakeholder Complexity	7	27
Existing level of stakeh...	7	17
their roles & respon...	4	4
who are them	4	8
Legal-policy backgrou...	6	10

Figure 31-Key Nodes for NVivo-Analysis

3 Analysis, Findings and Discussion

This section critically reviews the existing legal/policy and science approaches based on key challenges/gaps identified.

3.1 Challenges/Gaps related to GOVERNANCE in the existing Legal/Policy and Science Approaches

3.1.1 Institutional Barriers (working with different governance bodies)

Institutional barriers were highlighted as one of the major challenges to integrate CCA and DRR as well as to function within CCA and DRR domains.

The UK's DRR efforts or strategies have a strong, legal and regulatory framework which provides clear, legal and institutional settings at national and local levels. As described in Section 2.1.1.1, establishment of the Civil Contingencies Act is one of the great achievements in relation to disaster management. However, one of the key limitations of the Civil Contingencies Act is its limited focus on preparedness and capacity of adaptation events (UNISDR EC OECD, 2013). This idea was further strengthened by the preliminary data analysis. As identified from this, in the UK, DRR is separated by hazard. Therefore, a great deal of focus is only on disaster response and recovery rather than disaster risk reduction. An expert on disaster risk reduction, who took part in the ESPREssO data collection, described this context in detail as follows:

"There is low response for disaster risk reduction and climate change adaptation when compared to disaster response. There are plans for immediate response when there is a disaster, but, there is no particular attention to reduce the disaster risk. In DRR and I would think the same in CCA, there's more emphasis given to assets than the actual impacts and effects of a disaster. This idea is the same throughout the entire humanitarian community."

As a result of this context, the institutions for disaster response and recovery, disaster risk reduction and climate change adaptation are typically separate. As emphasised by one of our experts who works for a key government agency in DRR in the UK, the Department for Food and Rural Affairs in England (DEFRA) sets out the policy context for the Environment Agency UK, based on climate change adaptation, flood risk management and coastal erosion policies. However, these subjects are dealt with by two, different government bodies. As a result, when the policy context is developed for the Environment Agency, it does not always appear that there is a direct link among these subjects. Accordingly, all 15 experts in our study mentioned the need to provide the mandatory legal background to relevant authorities to develop policies and also, to implement them by themselves.

Further, even though the Civil Contingencies Act provides a coherent framework for preparedness and response, it does not always work effectively due to institutional barriers. The main criticism is that the existing frameworks are geared to deal with a normal situation. Accordingly, 12 out of 15 experts emphasised that the existing frameworks are good for a normal, steady state of working. It has been highlighted that when there is a normal, steady state, it works as a perfect cycle but, it does not provide any further guarantee to reduce the disaster risk or to reduce the vulnerabilities of the communities in the UK. The remaining three experts didn't have any specific idea about this.

Another key issue which emerged related to institutional barriers and was the lack of standards, regulations or measures. It was highlighted that there are government regulations for large-scale commercial developments such as shopping complex development. In this case, the developer must have precautions to reduce the potential environmental impacts which may lead to the generation of a natural hazard. However, these kinds of government regulations are not applied to large-scale housing developments which may have the same environmental impact. Therefore, it has been revealed that there should be a coherent government framework to provide guidance to the government institutions to manage and monitor similar situations.

The issue of devolving powers to the local government bodies was also identified as a key institutional barrier. As highlighted, the Environment Agency or the county council, have powers to take action to reduce disaster risk by providing solutions for potential hazards, for example, improving the river banks to reduce flood. However, it has been reported that the local town councils do not have any legal mandate or capabilities to deal with these. Therefore, as a result, if the Environment Agency or the county council are not involved in reducing disaster risks in the governing area of the particular town council, they have to find their own ways to live with potential disasters, rather than findings ways to reduce the disaster risk. The following is a quote from one of the climate change adaptation experts who participated. He represents the academic view:

"So, it's a town called (kept intentionally blank), and that has its own administrative base, a town council, but, it sits underneath (kept intentionally blank) as the regional authority and I think it's (kept intentionally blank) Council. And, yes, it's very clear that there is no capacity and legal mandate for the town council to protect itself from sea level rise, nor from flooding. So, there is alignment in terms of responsibilities and in terms of where power lies for risk reduction and for climate change adaptation and none of that is at the local level. It's all at the County Council seat in (kept intentionally blank)."

Adding to the preliminary findings, UNISDR EC OECD (2013) states that in the UK, current administration for risk governance is able to deal only with local boundaries rather than trans-boundary issues. Therefore, it recommends setting up systems to monitor the implementation of national guidelines at local levels and provide additional capacity building required to enhance risk management planning.

In addition to the issue of devolving the powers, Harris (2014), emphasised that due to continuous budget cuts in the UK, there is a shortage of staff working in adaptation, specifically in local authorities. Accordingly, the local authorities are concerned about immediate issues rather than future plans, hence, adaptation is no longer considered as a priority in local authorities in the UK (Porter et al., 2015). This indicates the need to have a long-term vision and common framework within government institutions to reduce the future vulnerabilities of society, rather than merely work on immediate issues. Further, the Committee on Climate Change (2015) highlights that regulatory, institutional and behavioural barriers hinder the introduction of adaptation measures. Accordingly, UK policies do not necessarily provide sufficient incentives for organisations to take adaptation into account when compared with other, short-term priorities. For example, limited evidence shows that climate risks are being evaluated fully or transparently alongside short-term priorities. As a whole, this indicates that the institutional and policy framework in the UK is geared to mainly deal with short-term activities which involve disaster response and recovery but not exactly to reducing the vulnerability of society to CCA or DRR. One of our experts, who represented a national NGO on disaster risk reduction, pointed this out and stated:

"No, there's no focus on disaster reduction. There's no focus on climate change adaptation or mitigation. The focus is on reducing public sector spending, it's on housing numbers, or it's on generating economic activity."

Another institutional barrier is too many separate groups which deal with CCA and DRR. In some cases, even within CCA and DRR, there are so many diverse groups. It was noted that the local authority context is fairly fragmented as there are separate departments for planning, local flood management, environment, climate change adaptation and a separate department for resilience. Also, the current institutional structure or its legal mandate do not facilitate co-ordination between these departments. All experts in our study mentioned this as one of the key issues. One of the CCA and DRR experts from an academic background elaborated on the issue as follows:

"Those different sectors do not always talk to each other, even when they do, they don't always collaborate. And sometimes for very good reasons, such as they're just too busy. They're too busy trying to deal with the emails that come in or the telephone calls that come in. But, that lack of collaboration is very noticeable in many areas. And it's the same if you go to some of the agencies. If you look at them, they simply say, I don't know, water quality and flood risk management have many areas where they need to collaborate and can have joint projects but they don't always necessarily talk to each other effectively or co-ordinate."

Throughout this section, the fragmentation of CCA and DRR was highlighted and the way in which institutional barriers have helped to create this fragmentation. Accordingly, as revealed from the preliminary data analysis as well as from the literature synthesis, there is a huge need to integrate CCA and DRR efforts in the UK. In addition, it is necessary to remove the fragmentation within the DRR context as well as within the CCA context. Figure 6 summarises the key issues discussed under the heading of 'Challenges in the existing Government Structures'.

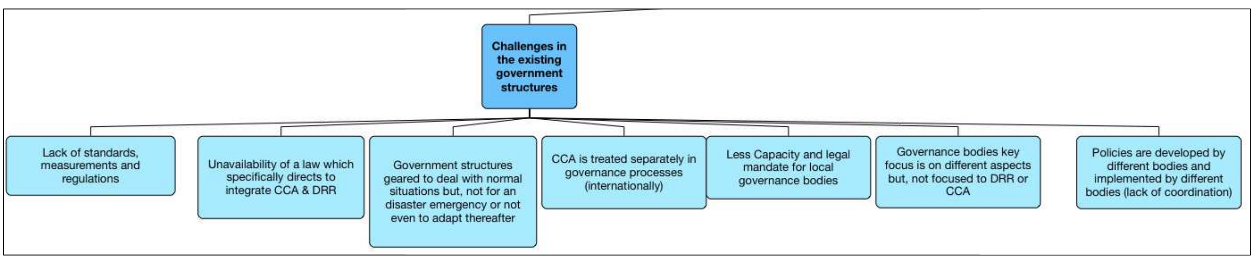


Figure 32- Challenges in the existing government structures

Further, figure 7 summarises experts' comments on the need for integration of CCA & DRR:

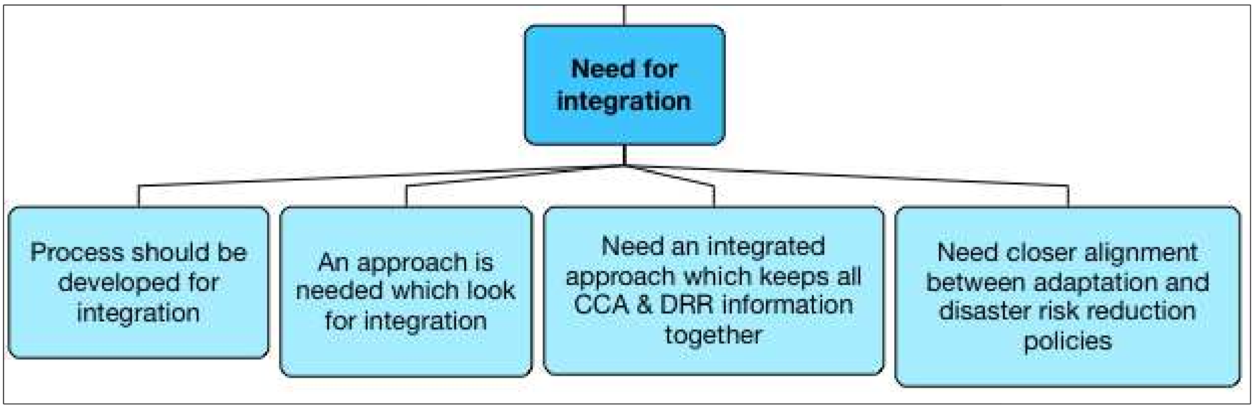
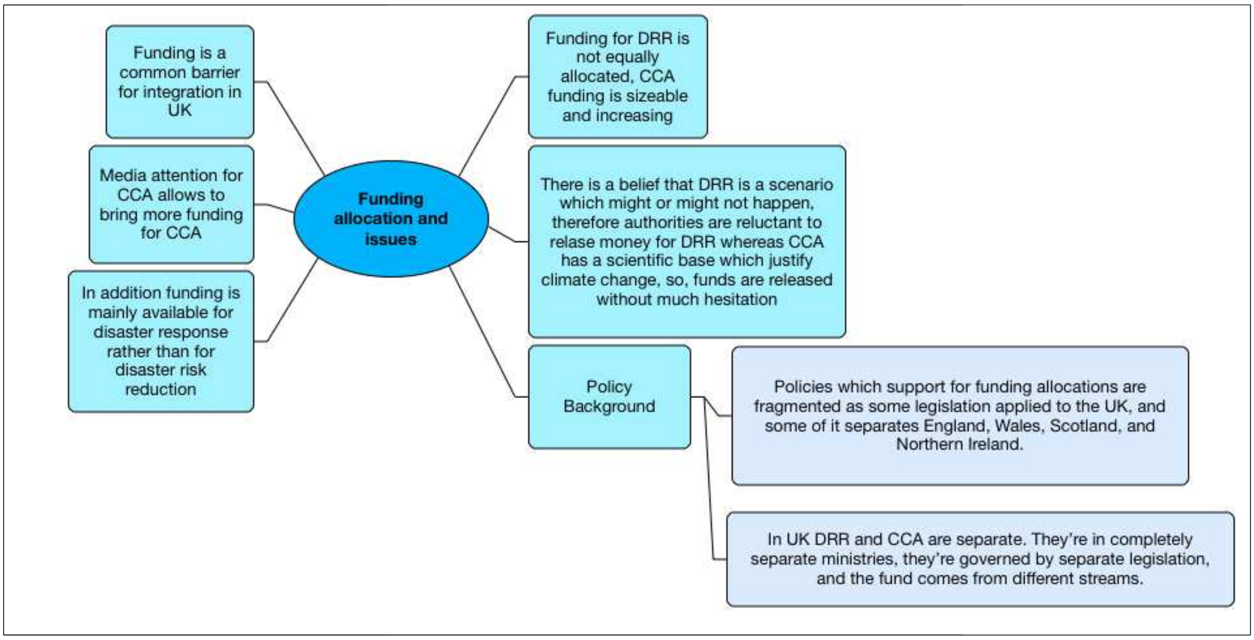


Figure 33-Need for integration of CCA and DRR

3.1.2 Funding Arrangements

In the UK, the key issue regarding funding allocation is linked to the institutional barriers. In Section 4.1.1, it was revealed that the key institution focus is on disaster response and recovery rather than disaster risk reduction or adaptation. Accordingly, the same issue is applicable to the funding context. However, when it comes to funding, key funds are allocated only for disaster response, not even for disaster recovery. As the Committee on Climate Change (2015) highlights, currently, most of the activities are limited by the government funded programme. As a result, in the event of a major disaster, contingency funds are available for immediate response activities only. Hence, there are no recovery funds made available by the Government or local authorities to cover damages to individuals and companies. Further, there are no specific policies for financial provisions for risk management planning (UNISDR EC OECD, 2013). This issue was clearly highlighted from the preliminary data analysis as well. As revealed, the current legal and policy context, which is bound to the Civil Contingencies Act, 2004, makes provision mainly for disaster response, but not for disaster recovery, disaster risk reduction or adaptation.

However, even within the available funding schemes, there are many issues with funding allocations. One of the issues of the UK's DRR strategy is that there is no specific and comprehensive estimation of budget allocation for disaster risk reduction efforts (UNISDR EC OECD, 2013). With recent budgetary controls in all sectors in the UK, the allocation for DRR programmes has been greatly affected. Adding to this, preliminary data analysis highlights that even within the available funding, funding for CCA is increasing and sizeable, whereas funding for DRR is poor. There are two key reasons for this situation as highlighted from the expert interviews. Most of the government funding bodies have a belief that DRR is a scenario which might or might not happen, whereas CCA is scientifically proven with scientific data and figures. Therefore, funding is released based on this scientific basis. The second reason is media attention. The media is more interested in climate change than disaster risk reduction and, therefore, CCA gets more political attention and more funding opportunities. However, as revealed from the analysis, it was highly recommended to integrate CCA and DRR, as then this funding allocation issue could be resolved. Figure 8 summarises the findings regarding the funding issue within its current policy context.



3.1.3 Political Will/Motivation

Similar to funding allocations, the main, key political attention is for disaster response rather than for CCA or DRR. However, within that context, CCA has more attention than DRR. As Desai et al. (2012) highlight, climate change adaptation was influenced by the changes in the political party system. For example, planning policies 1 and 25 were withdrawn by the party elected in 2010. This resulted in introducing centrally initiated adaptation approaches towards more decentralized, local level, 'bottom down' approaches. National, regional and local policies, from a number of different components of governance, have created and extended support for adaptation (Ingirige et al., 2013).

In addition, the UK Climate Plan was introduced in 2015 to control and take a lead role in emission reduction. It aimed to reduce temperature rises to below 2^0C, to deal with carbon budgets and to end the use of coal for power generation, along with a competitive, energy efficient, low carbon economy (Harper and Metternich, 2015). According to the EU Renewable Energy Directive, the Government of the UK is required to generate 15% of energy from renewable sources by 2020. Whilst some predicted that the UK referendum on leaving the EU will significantly affect the existing climate change policy and its related targets, experts revealed that there will not be any changes to the agreed level of emission reduction in the UK except for time scale changes. Further climate change in the UK has been identified as the key driver for business success (Seabrook, 2016).

According to the report published by the Committee on Climate Change in the UK, the impact of climate change and its devastating results have been identified in the coming decades. However, the report emphasises that the UK is poorly prepared for the inevitable impacts of global warming. Among these effects, deadly annual heatwaves, floods and coastal erosion, water shortages, natural environment and difficulties in producing food, are the most affected sectors in the UK (Carrington, 2016). Within this context, the experts' data analysis highlighted that there is a gap in understanding the concepts of CCA and DRR in the current political context. Accordingly, the available systems and policies do not support the political bodies in understanding and digesting these concepts correctly in order to take action. As a result of this, it is noted that the Environment Agency is struggling to embed CCA into the work they do to reduce society's vulnerability. Currently, they work on either disaster response or DRR but would like to embed CCA in their work. However, it has been identified that there is no clear political steer for this.

Accordingly, the key actions highlighted from the analysis to gain political attention include developing a co-ordinated system of government to identify the concepts of CCA and DRR and developing a policy/legal background to gain political attention. Figure 9 summarises the findings:

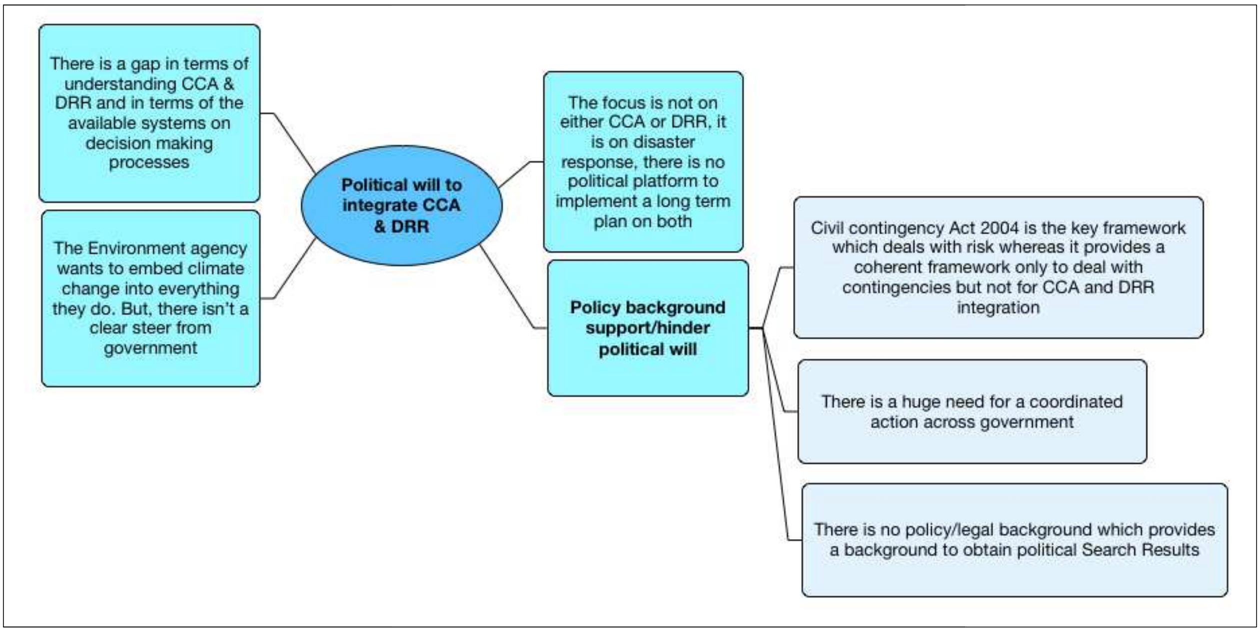


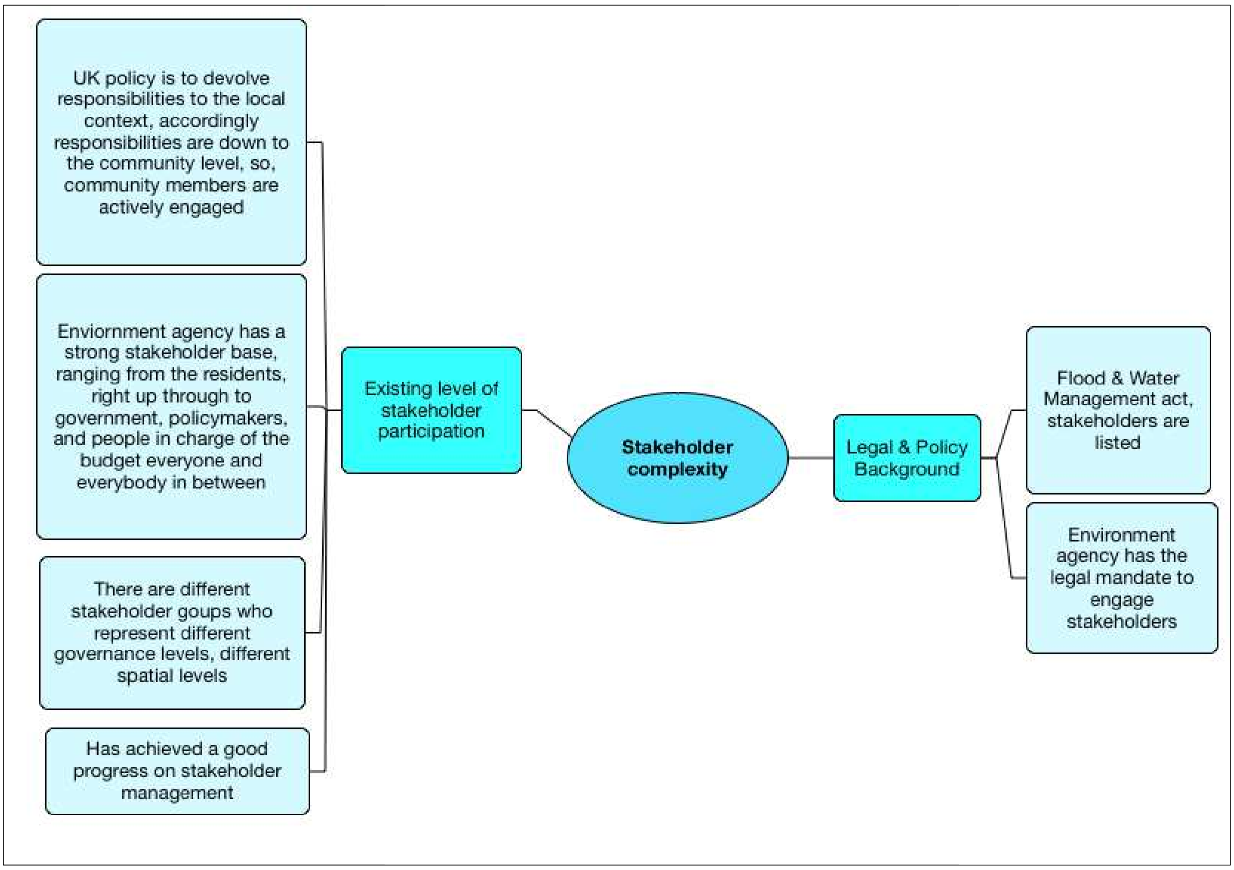
Figure 35- Political will, CCA and DRR

3.1.4 Stakeholder Complexity

The UK has achieved much progress in stakeholder management. Both in CCA and DRR efforts, stakeholder participation is identified as an important element. Scientists and stakeholders together can develop effective adaptation strategies with the knowledge of factual information along with local knowledge and experiences over time (Conde et al., 2005). One example of stakeholder participation in the UK adaptation strategy is the establishment of UKCIP, with the view of providing information to climate change decision-making. These decision makers represent the Government, private sector, trade groups and other interested groups. Meantime, the objectives and focus of UKCIP have changed over time, towards facilitating partnerships among stakeholders and promoting risk management. However, there are missing stakeholders within the risk management at UKCIP for example: charitable organizations, some sectors in the economy and so forth (Scheffer and Carpenter, 2003). Even though UKCIP has introduced stakeholder engagement (Tompkins et al., 2010), there are some concerns about the level of knowledge of the stakeholders included in the NAS (Lorenz et al., 2015). Even within the first NAP, the UK does not have adequate space for the household representation for an adaptation strategy (Porter et al., 2014).

Similarly, the UK Government faces other issues in translating legislation into action because of the lower representation of its stakeholders. For example: local media representatives were not involved in local preparedness plans and a lack of preparedness among the utility providers, due to their poor engagement in flood preparedness measures. Even though political will has advanced public sector involvement and efforts in climate change adaptation, private sector involvement was limited (Desai et al., 2012). However, as a whole, it is noted that the UK policy is to devolve responsibilities to the local context and, accordingly, responsibilities are down to the community level, so, community members are actively engaged.

Furthermore, the UK's DRR strategies ensure representation of different stakeholders, for example: the UK Met Office established the Natural Hazard Partnership between 12 technical and scientific agencies to provide information on natural hazards. The UK DRR strategies include many stakeholders including officials, specialists, volunteers and the business sector. In addition, the UK has undertaken significant efforts to work directly with citizens to increase resilience among communities. For example, the Natural Hazard Partnership consortium is playing an important role in improving the quality of information and is providing more co-ordinated and coherent scientific and technical advice for the Government and the resilience community (UNISDR EC OECD, 2013). These findings were further strengthened by the data analysis and it was revealed that the current UK policy to devolve responsibilities to the local context is working well. There is good stakeholder engagement at the local and community levels. Further, the Environment Agency plays a key role in stakeholder engagement and they have a strong stakeholder base which they use for disaster response as well as for DRR. Specifically, it was noted that the current legal/policy background is the key basis which produced provisions for a strong stakeholder base at the Environment Agency. The Environment Agency has the legal mandate to engage stakeholders and the Flood and Water Management Act lists the set of stakeholders to be engaged. The following is a summary of the context:



3.1.5 Procedural Gaps and Legal Frameworks

There are procedural gaps and legal frameworks that hinder the efforts of CCA and DRR within the UK. For example, the Civil Contingencies Act predominantly focuses on preparedness and capacities when dealing with disasters and the Act provides a sound framework for emergency management. Further, the Act was set to modernise and update out-dated legislation in relation to disaster management in the UK (UNISDR EC OECD, 2013).

However, UNISDR EC OECD (2013) criticised this for several reasons. For example, they emphasise more benefits could be gained if proper co-ordination was determined by the Act, between all stages of the disaster cycle: prevention, preparedness and response. As they further state, the overall co-ordination of response activities could be problematic due to different levels of capacities among organisations. Bosher et al. (2007) describe that the Act's emphasis was limited to emergency response and, accordingly, there is no opportunity for the proactive requirements of disaster management.

Furthermore, the devolved administration system makes it difficult to co-operate in the case of trans-boundary issues arising. This is because the risk governance within the devolved administrations deals only with the boundaries of the local resilience efforts (UNISDR EC OECD, 2013).

This was clearly demonstrated from the data analysis. Accordingly, it was revealed that the UK has the attitude and belief to be self-dependent during disaster response and recovery, as well as in DRR and CCA. Linking to political willingness, it was discovered that the political bodies in the UK are not much interested in trans-boundary crisis management and therefore, there are no procedures to effectively work with neighbouring nations to manage them. One of the CCA and DRR experts in our study, who represents academia, explained this issue in detail as follows:

"At the UK level, so we're talking about (Intentionally left blank), I see no political will whatsoever to have much to do with major issues outside the UK. It's incredibly insular, there's almost zero recognition that other countries have a lot of expertise to offer. There was this brilliant article where some (Intentionally left blank) government person came over to talk to the (Intentionally left blank) about flood-risk reduction, and the way it was reported is: (Intentionally left blank) Experts Seek English Advice on How to Deal with Floods. There's no element of exchange. There was no element of mutual understanding. There was no recognition that even though the (Intentionally left blank) are international leaders in dealing with storm surge. The UK should at least look outwards and recognise they always have something to learn. The whole attitude was insular, almost like England and Wales know everything, and so, people come to us for advice, rather than saying, look, we can help each other, we can get help from each other, we can teach each other, we can learn from each other, we can exchange."

Figure 11 summarises the procedural gaps in the UK for trans-boundary crisis management and figure 12 links procedural gaps with political willingness for trans-boundary crisis management and the current context for that.

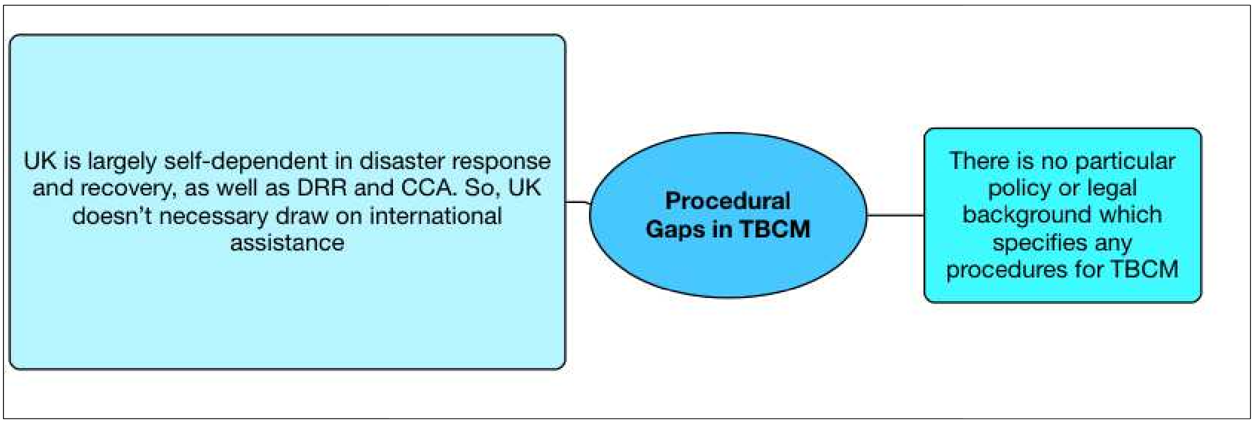


Figure 37-The UK's position in trans-boundary crisis management

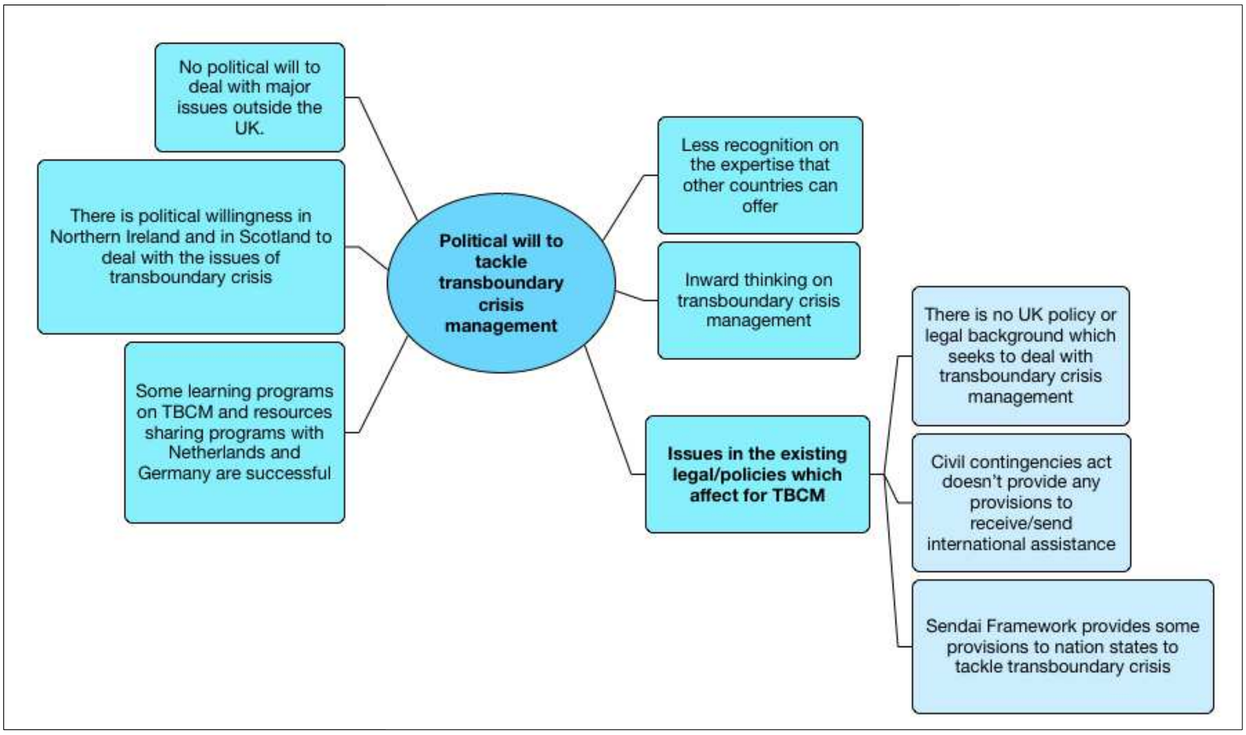


Figure 38-Political will to tackle TBC

3.2 Challenges/Gaps related to RISK in the existing Legal/Policy and Science Approaches

3.2.1 Risk Perception and Risk Assessment

3.2.1.1 *Risk Perception*

Climate risks are assessed by scientists (Parry, 2007), and hence, the risk perception among the public is different to the scientists' view point (Slovic, 1987, cited in (Taylor et al., 2014). Moreover, climate risk awareness among the general public is limited due to many reasons (Kahan et al., 2012). For example, this may be due to: scientific illiteracy (Pidgeon and Fischhoff, 2011); their bounded rationality and nature which is either based on consciousness or heuristic views of climate risk (Kahneman, 2003) or cultural cognition (Kahan 2010, cited in (Taylor et al., 2014). However, public perception about climate risk is an important element in disaster management as well as adaptation strategy, since members of the public engage with the effects of climate change. However, little empirical evidence is available on climate risk perceptions on climate change adaptation when compared to climate change mitigation (Taylor et al., 2014). According to the disaster management experts in the UK, this is a common issue, and they suggest developing common guidelines, in simple language, to be disseminated to the general public including professionals, politicians and any other stakeholders. This will enable some common understanding between the general public and the other stakeholders.

Further, it was highlighted that in the UK, there are different opinions about the impact of climate change and natural hazards. Some believe that the impact of natural hazards to the economy, infrastructure and residents will be marginal, whereas others argue that the occurrence of extreme weather events will increase and climate effects will be significant (UKCIP, 2002). For example, with the changing climate, the threat of flooding will be significantly increased in the UK (Bosher et al., 2007); the risk of floods would be increased four times by 2080 (Kapucu, 2009). However, generally, people are reluctant to accept and recognize the possibility of the potential future risk of natural disasters. Therefore, additional efforts should be made to educate citizens on prevention to build more resilient communities (Kapucu, 2009). The culture of risk prevention is weak because risk awareness is low among the population of the UK (UNISDR EC OECD, 2013). In addition, many people do not believe that there is a relationship between the occurrence of weather events and climate change, including some scientists, the media and general public (Pall et al., 2011, Gavin and Marshall, 2011). Limited studies have been conducted to identify the extent to which climate awareness is important for climate change adaptation decisions (Taylor et al., 2014).

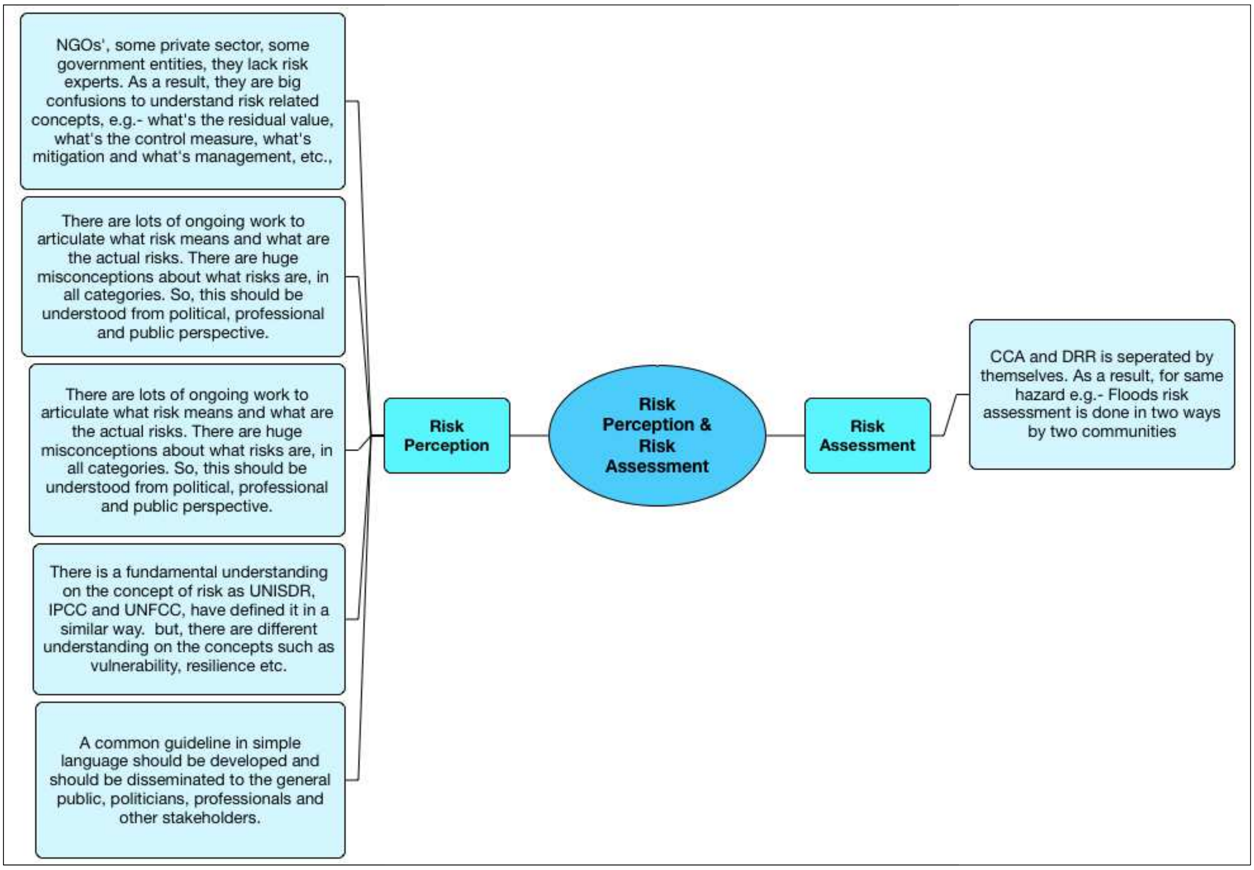
In addition, it was identified that some NGOs, some private sectors and some government entities operating in the UK, lack risk experts. As a result, there is confusion over risk-related concepts such as: What is the residual value? What is the control measure? What is mitigation? What is management? Also, it is worth highlighting that there is a fundamental lack of understanding on the concept of risk. UNISDR, IPCC and UNFCC have defined it in a similar way but there are different understandings of the concepts such as vulnerability and resilience.

3.2.1.2 *Risk Assessment*

As mentioned earlier, UK climate change risk assessment is based on UKCP09 climate projections. Accordingly, this assessment helps country-wide risk management, preparedness and planning, with the help of a multi-hazard approach and within a five-year time horizon. Their risk matrix provides an efficient method to decide the level of warning as an input to the UK's early warning system, for example: the Flood Forecasting Centre provides flood forecasts and early warnings (UNISDR EC OECD, 2013). It is recognized that UKCP09 is strong in terms of understanding, higher acknowledgement of uncertainty and the larger amount of user input in UK climate projections (Tang and Dessai, 2012). Climate information is the basis for long term climate change adaptation planning in the UK. A decade ago, there was a lack of climate change information among the officials of local authorities (Porter et al., 2014).

However, there are many aspects to be further considered for an effective risk assessment system for the UK. One of the criticisms of the present climate change adaptation policy is that its focus is limited to adaptation preparedness only (risk assessment), (Desai et al., 2012). This is further supported by the report revealing that present risk assessment processes in the UK mostly target emergency preparedness and planning only, rather than using this risk assessment to reduce risks and vulnerabilities at local levels (UNISDR EC OECD, 2013). Another major criticism is that the projections offer a false sense of certainty in adaptation planning and decision-making (Frigg et al., 2015, Tang and Dessai, 2012). Tang and Dessai (2012) criticise the usage of Baysian probabilistic projections in climate risk assessment since it reduces the saliency of decision-making. This may affect the effectiveness of climate adaptation planning.

Similarly, there are some knowledge gaps in climate change estimations although they are based on numbers and climate change figures. These knowledge gaps include the impact of snow cover and snowpack melting on river flows which are not taken into consideration by the scientific community. This may create issues for proper adaptation measures (Wilby et al., 2008). In addition, all of the 15 experts who participated in the study stated that risk assessments are done by both CCA and DRR communities for the same disaster in two different ways which has duplicated work with less efficiency.



3.3 Challenges/Gaps related to SCIENTIFIC FRAMEWORKS in the existing Science Approaches

UK Climate Change Risk Assessment (CCRA) has been identified as a system that uses scientific assessments to optimize climate change adaptation decisions (Porter et al., 2014, Tangney, 2016). The UK Government claims that their risk assessments are independent and impartial in policy making (Defra, 2012). However, the UK's CCRA is questionable regarding its effectiveness as a device for information transfer or institutional learning. Furthermore, the UK's CCRA is only considered as a tactical instrument to get political support for various policy positions. This makes it difficult to provide a wider scope for institutional learning about the character and management of climate risks. Among these problems, the method used to risk assess is inadequate for explaining climatic problems and does not provide any instrumental use of climate science. This also reduces the opportunity for learning about policy making. The UK's risk assessment is based on the linear-rationalist method which assumes that climate adaptation problems are tractable, and can be defined correctly to facilitate good practice in decision-making, generating robust decisions with the best information available (Tangney, 2016).

Compared to other countries, the UK engages in significant levels of climate change research, nevertheless, policy making is influenced by cultural preferences (Jasanoff, 2011, cited in (Lorenz et al., 2015). Furthermore, the policy making process does not consider climate change, model predictions and uncertainties within the UK NAS (Lorenz et al., 2015). For example, when compared to other EU countries, the UK NAS has included only future society, GHG emission and climate model as the identified uncertainties in their NAS. As a result, there are qualitative indicators for sources of information, climate scenarios and climate models for the UK's NAS when compared to Germany. There are no specific details on climate scenarios in the UK's NAS (Lorenz et al., 2015). Furthermore, some severe floods in the UK were generally supported by the thermodynamic arguments without explanation through the complex, hydro meteorological scientific base (Pall et al., 2011).

Most climate modelling depends on simulations. There may be conflicts, even among different scientists whose disciplines use different methods. This may affect the credibility of scientific conclusions (Pidgeon and Fischhoff, 2011).

3.4 Challenges/Gaps related to COMMUNICATION in the existing Legal/Policy Aspects

In the UK, both the media and internet are used as a communication strategy to make people aware of DRR. However, there is no record of introducing DRR knowledge in the school curriculum in the UK (UNISDR EC OECD, 2013). As highlighted by the UNISDR EC OECD (2013), there are many ways communication strategies hinder the CCA, DRR and their integration efforts in the UK. For example, there is no systematic data base for disaster losses and damages in the UK; there are issues in understanding early warning messages by different responders due to organizational differences (created as a result of administrative borders) between stakeholders (for example, the Met Office and Environment Agency); the preparedness strategies are communicated via only online systems which are not accessed by many people. Whilst the UK has developed a number of good mechanisms and practices for information sharing and risk communication, due to the sensitivity of the information, it is not accessible to all businesses or science communities (UNISDR EC OECD, 2013). Further, another major problem faced by the climate scientists is communicating their scientific findings to the non-scientific community for example, the general public and policy makers (Pidgeon and Fischhoff, 2011).

In addition to the literature synthesis, data analysis further highlighted the key issues in communication and information management and those can be discussed under four key areas, namely:

- Communication between CCA and DRR communities
- Communication between academic community and practitioners
- Communication between practitioners and the general public
- Communication with the adjoining nation states on trans-boundary crisis management

3.4.1.1 *Communication between CCA and DRR Communities*

Proper communication between CCA and DRR communities is essential in order to integrate CCA and DRR as well as to bridge the gap between science and legal/policies. Generally, CCA develops scientific data whereas DRR produces data based on community perceptions. Accordingly, these scientific data generated from CCA should be transferred to the policy level via DRR to the community level. Accordingly, it is essential to have a proper communication channel between CCA and DRR.

However, as the analysis highlights, currently, the CCA terminology is fairly separate. It is more technical or scientific and cannot be translated into simple English. As a result, it cannot be communicated at the community level of DRR. Further, it is noted that CCA and DRR collect two sets of data by their nature, e.g. the CCA community collects weather data and how those data can be converted to identify potential flood risks and so forth, whereas the DRR community, looks on the number of houses affected or at risk. However, the issue is not collecting different types of data, but rather, the CCA terminology is too technical and it cannot be translated to the community which DRR deal with.

Even though this is the current context, the key issue is that there is no proper or straightforward communication between CCA and DRR communities unless there are particular partnerships that have grown up informally between different entities. Whilst both disciplines do the same thing which is reducing the vulnerability of society, it is not viewed in that way by the two different communities.

Nevertheless, it is clearly identified that there is no statutory demand for information sharing between CCA and DRR communities. The figure below summarises the findings:

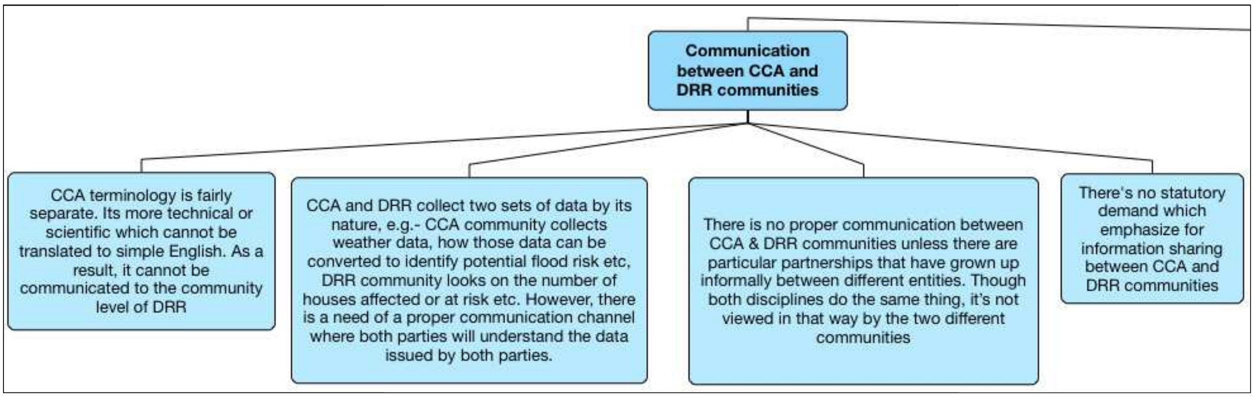


Figure 40-Communication between CCA and DRR communities

3.4.1.2 *Communication between the Academic Community and Practitioners*

Communication between the academic community and practitioners is important in order to transfer knowledge to the practitioners which has been gained from the scientific research conducted by the academics. This is not one-way communication, where the academic community also needs to adapt the latest tools and concepts in practice in order to improve their research as well as to improve the teaching quality. Generally, the analysis results highlight that there is proper communication between these two parties. It was highlighted that many UK universities have collaborations with national level organisations which deal with CCA and DRR. Further, there are non-government institutions who are active in DRR, sponsoring PhD students in order to keep the link and proper communication between these two parties, for example, Rescue Global. In addition, the Environment Agency has a strong link and collaborations with many leading universities in the UK. It was discovered that there is no legal/policy mandate which specifies or directs the communication between the academic community and the practitioners, but, as described, it is already there in a positive way. The figure below summarises the findings:

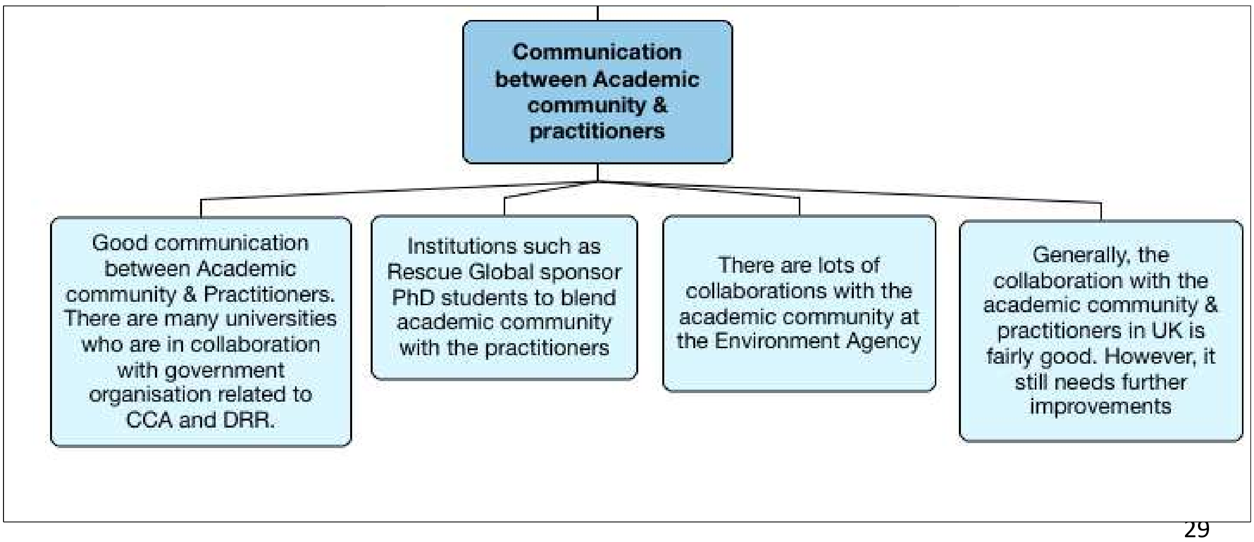


Figure 41-Communication between the academic community and practitioners

3.4.1.3 *Communication between Practitioners and the General Public*

Communication between practitioners and the general public is important in order to bridge the gap between science and legal/policies. Generally, once new knowledge is generated through science, it should be disseminated via practitioners into practice and that knowledge should be transferred to the general public. As the analysis highlights, the UK has achieved good progress on this.

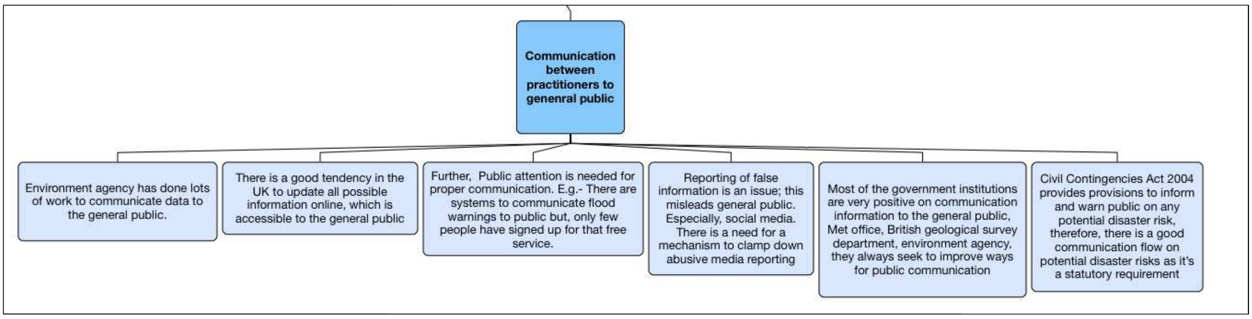
The Environment Agency, which is one of the main bodies in the UK for disaster management, has done a great deal of work to communicate data to the general public. Basically, they are happy to disseminate specific data on disaster risks online which people can easily access. In addition, the Environment Agency holds different types of workshops and programmes to disseminate their findings to the general public. Further, most of the government institutions are very positive on communication of information to the general public. The Met Office, British Geological Survey Department, Environment Agency always seek to improve public communication.

The Civil Contingencies Act, 2004, makes provision to inform and warn the public of any potential disaster risk and therefore, there is good communication on potential disaster risks as it is a statutory requirement. However, there are two major issues in the communication flow between the practitioners and the general public. The first issue is the public interest. Even though the government organisations communicate to the community, people are reluctant to appreciate them as they have the perception that a disaster is unlikely to happen to them. According to one of the DRR practitioners who participated in the study:

"People think a disaster may not ever happen to them. They are very keen when a disaster happens somewhere in the country, but, refuse to understand that all communities have a risk of a potential disaster. So, until it happens they do not want to be updated about the disaster risks and its consequences."

Accordingly, in the UK, there is a need to integrate DRR and CCA into the school education system to increase awareness as well as to change perceptions in the long run.

Another key issue is the reporting of false information to the general public. People in the UK are highly active on social networks and there are several groups who report false information on social media. As a result of this, people have lost trust in reliable information which is released online, even by the relevant bodies. Accordingly, there is a need to clamp down on incorrect media reporting. Figure 16 summarises the findings:



3.4.1.4 *Communication with the adjoining Nation States on trans-boundary Crisis Management*

Generally, the UK is more independent when it comes to disaster management and does not have a strong communication link with the nation states on trans-boundary crisis management. 10 out of 15 experts emphasised that currently, in the UK, there is no political willingness to communicate with the nation states on trans-boundary crisis. 3 out of the other 5 experts in the study did not give any specific answer to this issue. However, 2 experts mentioned that there are many informal partnerships between the nation states but not any formal agreements. Accordingly, it can be noted the country is more independent and does not have much involvement in this issue. Reference to Section 4.1.5 on procedural gaps and legal frameworks emphasises the current status of this particular issue.

4 Conclusions & Recommendations

The United Kingdom has a strong legal/policy background in regard to CCA and DRR. However, the key issue is fragmentation. Due to this fragmentation of policies and the legal background, CCA and DRR are in separate departments and ministries. They operate in a totally isolated manner. Since there is a strong scientific background for CCA, there is huge political motivation for CCA rather than DRR. As a result, funding is attracted by CCA organisations which leaves little allocation for DRR activities. Since, CCA innovations are more science oriented, that knowledge needs to be transferred to the local level which should be done via DRR, the basis for community and local level interventions. However, since DRR attracts little political will and low levels of funding, the DRR community is not in a strong position to transfer this knowledge to the community level. As a result of this overall context, communication between CCA and DRR communities is poor which has led to competition between them rather than collaboration.

The UK's practice is to be more independent, thus, there is less room and interest for trans-boundary crisis management. There is no legal/policy in the UK to engage in trans-boundary crisis management. However, the UK has a strong communication network between the academic community and the practitioners which has helped to transfer scientific knowledge into practice and thence to the legal/policy platforms. Further, the UK is keen to transfer knowledge on disaster management to the general public, therefore, most of the information is freely available. At the same time, it was highlighted that the enthusiasm of the public should be further encouraged in order to effectively disseminate knowledge.

In order to overcome these issues, the current legal/policy and scientific backgrounds should be altered according to need. Therefore, during the next phase of this study, which is known as task 2.2 in the ESPREssO project, there will be a detailed review to find out how to overcome these issues by enhancing the current legal/policy and scientific backgrounds.

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<u>Annexture 06</u>

ESPREsSO

Enhancing Synergies for disaster PRevention in the EurOpean Union

Synthesis report of legal, policy and science approaches within the frame of disaster risk reduction (DRR) and climate change adaptation (CCA)

(National Report- DENMARK)

By:
University of Copenhagen, Denmark
April, 2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 700342. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein

Contents

1 Introduction

This report presents an insight into Denmark's legal/policy and science approaches to Climate change adaptation (CCA) and Disaster risk reduction (DRR). The present section throws light on its geographical aspects and a brief disaster profile. The next section will provide insights into the Danish disaster management system; arrangements for CCA and science approaches in the country.

Denmark lies in the Nordic region of Europe. It is the smallest country of the Nordic states with the city of Copenhagen as its capital. Denmark has a long coastline of 7,314 km and the area of Denmark is 43,094 sq.km[§§§§§§§§§§§§§§§§§§§§§§§§§§]. It lies very close to Sweden and borders with Germany. Denmark is divided into five regions governed by regional councils.

The common disasters affecting Denmark include floods, storms, cloudbursts, terror attacks, oil spills. Some of the disasters in the recent years are- storm surge in January 2017; repeated floods in Southern Denmark in 2015; terror attacks in 2015; storms in 2013 winter; Copenhagen cloudburst in 2011 (Eydal et al. 2016). In the coastal areas, hurricanes and storms lead to storm surges. A survey by the Danish Insurance Association in 2012, shows that the storm damages in the last five years had impacted approximately one in every 10 house owners (DEMA 2013). The most recent disaster, the storm surge in January 2017 had the Danish Emergency Management Agency (DEMA) working with high capacity pumps to keep the water out of residential areas. The storm surge is estimated to have cost at least 10 million DKK for municipal preparedness (1,4 million Euros) (DR 2017).

Every third year DEMA issues an overview of the biggest threats against Denmark. The latest was issued in the spring of 2017 and highlights 13 threats to Denmark. Besides the 13 threats the report points to four overall "trends" that might affect the risk landscape for Denmark: changes in geopolitical security, antibiotics resistance, irregular migration and increasing traffic in the Arctic theatre (DEMA 2017).

Denmark has chosen to take a high-profile strategy on Climate Change adaptation, and in particular costal municipalities of Denmark, have in recent years made large investments in city planning projects. These projects have close links to DRR (although not made explicitly) as most disasters faced by Denmark are water and climate related.

[§§§§§§§§§§§§§§§§§§§§§§§§§§] http://ec.europa.eu/echo/files/civil_protection/vademecum/dk/2-dk-5.html#topo

1. Description of existing legal/policy and science approaches

In this section we will account for the present legal and policy frameworks relevant for disaster risk reduction as well as climate change adaptation.

1.1 Legal/policy and science approaches in relation to DRR

Already on 1949, the first Danish Civil Defense Act was introduced[*]. The Act was based partially on an existing Act organizing the air raid defense from 1935, Law no. 161 of 11 May 1935, modified by law no 180 of 29 April 1938, and partially on the experiences gathered during the five-year German occupation of Denmark from 1940 to 1945. The present legal framework for disaster risk management is the Danish Emergency Management Act (Beredskabsloven, henceforth EMA) from 1992[†]. The aim of EMA is "to prevent, limit and redress personal injury and damage to property and the environment arising from accidents, disasters and catastrophes, including acts of war, or imminent danger of such" [‡]. The Danish Emergency Management Agency (DEMA) was established in 1993.

The Danish disaster management system is organized in three levels: a municipal, a municipal-support level and a national level. The municipal level consists of a full fire and rescue service, organized after the preference of the municipalities either as a public professional, a private or a voluntary entity.[§] According to a political accord stroke in 2012, the municipal level today is organized in 24 cross—municipal emergency management entities.[**] The dimensioning of the municipal rescue preparedness is done by the local municipal councils based on a local risk assessment.[††]

Besides the municipal preparedness, any actual disaster response (Local Command in response area according to the figure above) is coordinated by the Danish police.[‡‡] The municipality is further responsible for fire inspections and decisions on fire-standards.[§§] If the municipal emergency services do not have the necessary capacity to handle an accident or disaster, it may call upon the assistance from the five emergency response centers (Evenly distributed across the country in Thisted, Herning, Haderslev, Næstved and Allinge all on 24-hour turn-out duty). The regional and state levels are, in legal terms, one entity organized in five regional focal points and a central coordination. In case of comprehensive accidents requiring either special or large amounts of equipment and personnel, the municipalities may call directly on the assistance of DEMA's five emergency response centers.

[*] Law no. 152 of 1 April 1949 (L40 of 10 November 1948).

[†] Law no 1054 of 23 December 1992

[‡] EMA, Consolidation Act no. 660 of 10 June 2009 § 1, the aim is unchanged from the 1992 - law no. 1054 of 23 December 1992. A few changes to the present Consolidation Act no. 660 have been adopted, see Law no 514 of 26 May 2014; Law no 634 of 08 June 2016, § 1 and Law no 1720 of 27 December 2016.

[§] The only limitations to the organization of the emergency response is (besides the fact that it must correspond to a risk profile of the municipality) as a minimum one educated group leader must be present, and there must be enough personnel to use the necessary equipment, Statutory Order no. 765 of 3 August 2005 on Risk based municipal emergency management § 6. The first turn-out must happen within 5 minutes of the alarm, Statutory Order no. 765 of 3 August 2005 on Risk based municipal emergency management § 7.

[**] Political Accord on Emergency management services of 2012 ('Aftale om Redningsberedskabet 2012'). For a map of the present cross-municipal entities see http://brs.dk/beredskab/idk/kommunalt_beredskab/sammenlaegning-af-kommunale-redningsberedskaber/Pages/kort-over-sammenlagte-kommunale-beredskaber.aspx

[††] Statutory Order no. 765 of 3 August 2005 on Risk based municipal emergency management § 2. The Statutory order replaces the former so called Dimensioneringsbekendtgørelse, Statutory Order no. 1010 of 11 December 2002

[‡‡] The overall response in connection with major damages are coordinated by the police commissioner, see EMA § 17.

[§§] Cf. EMA §§ 34-36. This applies even in cases where other authorities conduct the inspection; see UfR 2003.199 V (a municipality found liable for inadequate information on a property's fire conditions, though the inspection was carried out by the Police). For further elaboration of the municipal obligation see Statutory Order no 175 of 25 February 2008, and further Guidance on Fire inspection [Vejledning om brandsyn] no. 10 of 1 April 2008.

Five principles characterize the Danish disaster risk reduction and management efforts. Thus, today the emergency response in Denmark must, according to DEMA, be understood through the same basic organizational concepts for all emergency response, the principles of Sector-responsibility; Similarity; Subsidiarity; Cooperation; Precaution (DEMA 2015).

General principles for preparedness planning and crisis management

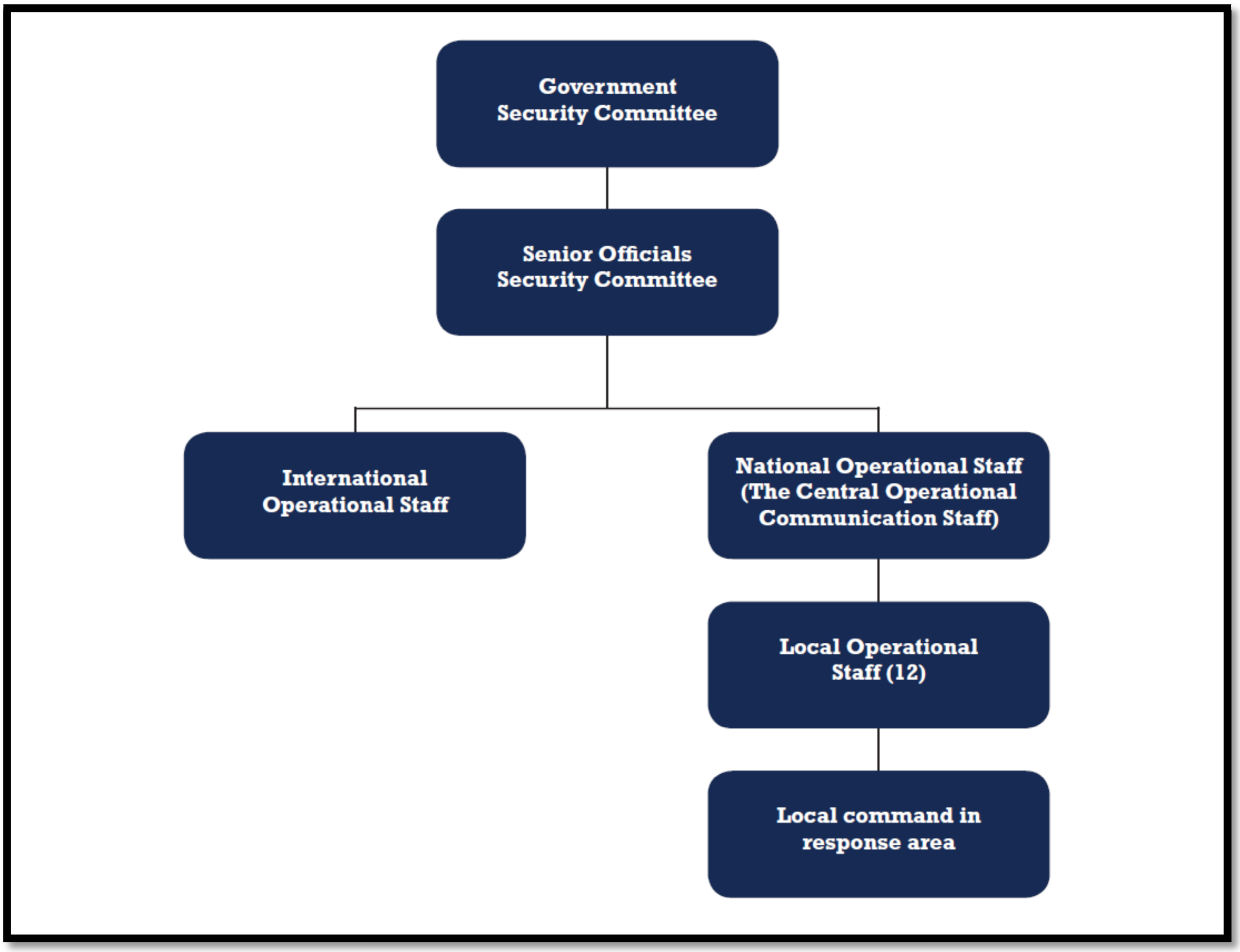
- Sector-responsibility: The department/agency which has daily responsibility for a given sector, retains this responsibility during crises.
- Similarity: The procedures and division of responsibilities applied on a day-to-day basis shall to the largest extent possible also be applied in the crisis management.
- Subsidiarity: Emergency management and crisis management should be handled at the most local organisational level possible, closest to the citizens.
- Cooperation: The authorities are responsible for cooperating and coordinating with each other in terms of both preparedness planning and crisis management.
- Precaution: In a situation with unclear or incomplete information, it is always preferable to establish a higher, rather than a lower level of response. Subsequently, quick adaption is necessary to avoid wasting resources.

National Emergency Plan, 6th edition.

Source: (DEMA 2015:5)

The national crisis management organization consists of two levels coordinating national-level emergencies: The Government Security Committee, and the Senior Officials' Security Committee. The committees function as a Matryoshka doll, all referring to each other upwards in the system. In principle, all decisions of importance regarding national security is taken by the Government's security committee chaired by the Prime Minister of Denmark (after recommendation from the subjacent bodies). Furthermore, the Crisis Management Group (CMG) is a planning forum for continuos revision of the Danish crisis management system. There are different members from various ministries who are part of the CMG.

In addition, two operative staffs exist: the National Operative Staff (NOST - national operative stab) and the International Operative Staff (IOS – international operative stab). NOST "regularly supplies the participating authorities and the Government's crisis management organization, as well as other central sectors, with the information necessary for the authorities to make quick and effective decisions" (DEMA 2015:10). The IOS responds to assist major incidents abroad where Danish citizens need assistance.



Source: DEMA 2015

1.2 Legal/policy and science approaches in relation to CCA

Denmark has a long history of flooding and flood response. In this light, CCA is a new, but nonetheless increasingly influential agenda. Contrary to the DRR, which are embedded with the emergency preparedness services and the municipalities, there is no comprehensive legal framework on CCA in Denmark. By this, we mean that Denmark currently has huge focus on climate mitigation. The majority of the aspects dealt with at the national level focus on energy and carbon-reduction projects. This however, does not mean that CCA plays a smaller role in Denmark. On the contrary, a large number of different sets of regulation addressing CCA have emerged in recent years.

The implementation of CCA efforts in Denmark is lead from municipal level. According to a 2012 report this is intentional: “Climate change adaptation is first and foremost locally based- at the municipal authorities, companies or individuals. The individual stakeholders know the local conditions best, and are consequently in the best position to make decisions on adaptation” (Taskforce on Climate Change 2012:7). In 2007, following a major local governance reform that merged formerly 174 municipalities into 98, decentralized many tasks including environmental related actions such as CCA. In 2008 the Danish Government introduced a Climate Change Adaptation Strategy (Danish Government 2008). This document outlined a range of policy options available for municipalities in implementing CCA, but did not impose any specific obligations. In conjuncture with the strategy the The Danish Portal for Climate Change Adaptation was established to document all relevant material on CCA (http://en.klimatilpasning.dk/) – and serve as resource database for individuals, municipalities and businesses.

In 2014, the Danish Climate Change Act was adopted. It specifies

- Establishment of an independent, academically based Climate Council.
- An Annual Climate Policy Report.

- Process for establishing new national climate targets.

Following this, in 2015, a climate council was established. The role of the independent Climate Council is to provide advice to the government on climate matters with the main aim of a low-carbon society. The climate council receives permanent annual funding of DKK 9 million from the Danish Finance Act from and including 2015 (Danish Government 2014).

The Danish Council on Climate Change has the following tasks:

- "evaluate the status of Denmark's implementation of national climate objectives and international climate commitments,
- analyse potential means of transitioning to a low-carbon society by 2050 and identify possible measures to achieve greenhouse gas reductions,
- draw up recommendations to help shape climate policy, including a selection of potential mechanisms and transition scenarios,
- contribute to the public debate. The Danish Council on Climate Change must, to the extent required in the preparation of its analyses and other work, consult and involve relevant parties, including, among other business interests, social partners in the labour market and civil society." [*]

In the municipal planning-Act (*Planloven*)[†], an obligation to develop municipal CCA-plans (*kommunale klimatilpasningsplaner*) as well as to make so-called climate-based district plans (*klimalokalplaner*) were introduced in 2012 (Denmark Government 2012). Accordingly, municipalities are obliged by law to specifically address the potential effects of climate change in all aspects of their city planning and development. Since 2012, every municipality accordingly had to carry out a risk assessment and specific actions.

The municipality of Copenhagen, the biggest in Denmark, adopted an ambitious 2025-plan to adapt to sea level rises, future extreme weather (increased rainfall in particular) and rising temperatures in 2011 (Københavns Kommune 2011). The price for the plan was 10-12 billion DKK equivalent to around 1,5 billion EUR.

In order to underline Denmark's big and cross-political dedication to the climate issue, a specific ministry was made following the 2007-parliamentary election. The present Ministry for Energy, Utility and Climate however has kept a strong focus on climate change mitigation, by promoting clean or green energy production, rather than adaptation.

Some regulatory focus has been on water management. The Danish drinking water supply is based on subsoil water reservoirs and potential sea-levels rise might affect the levels of subsoil water in particular in coast-near areas.[‡] However, even with a significant regulatory activity level, the CCA dimension seems minor. The two main principles of the Danish Climate Policy lies in *Integration of climate change mitigation in other policy areas* and *Combining an ambitious climate policy with growth and employment* (Danish Government 2012:55-56). Other principles include timing and action under uncertainty; cost effectiveness; competitiveness; limited possibility for public financing (to keep in line with the sustainable economic policy); support for a long-term transition; and consumer related emissions.

1.3 Legal/policy approaches combining CCA/DRR

In Denmark, there are no legal or policy instruments specifically set out to integrate the efforts done in respectively CCA and DRR. However, in a number of instances, it is not clear whether a concrete effort is a CCA or DRR-based initiative. For instance, the municipalities have a particular responsibility to monitor and assess the risks of floods from local watercourses and lakes[§], a framework based on the European flood directive[**]. While this is considered an attempt to adapt to a climate-induced risk by some authors (Hannibal et al. 2011), the regulation resembles a DRR-based logic with risk-based assessment and a

[*] http://www.xn--klimardet-b3a.dk/en/about-danish-council-climate-change

[†] Consolidation Act no 1529 of 23 November 2015. The relevant amendment is Law no. 579 of 18 June 2012.

[‡] See Consolidation Act no. 125 of 26 January 2017

[§] Consolidation Act no 1618 of 10 December 2015, Bekendtgørelse af lov om vurdering og styring af oversvømmelsesrisikoen fra vandløb og søer.

[**] 2007/60/EF

strong focus on available response capacity. Similarly, the Environmental Protection Act[†] contains provisions on the management of wastewater, which on the one hand is directly relevant to DRR, but on the other hand could be subject to danger if exposed to climate-induced hazards like extreme weather. This is also the case the Natura 2000 implementation arrangements.[‡] Jebens and Sørensen (2016:293) indicate that "[i]n Denmark, DRM and CCA only vaguely appear in legislation and, except for EU legislation in relation to the Floods Directive, no explicit links between DRM and CCA exist. In addition, current coastal protection legislation involves a process which is difficult for the civil society to understand". The analysis and discussion sections of this report focus on the need to move towards integrating or bring closer efforts of CCA and DRR.

1.4 Science Approaches

In the last ten years, the Danish government has been promoting different research and education programs relevant to this report. Some of the major funding schemes for research are discussed below. Furthermore, the section provides a brief presentation of research centers and groups working on projects of various aspects of disasters and climate change adaptation.

1.4.1 Relevant government funded research frameworks

Relevant government funded research frameworks include:

- Denmark's Development Cooperation is referred to as DANIDA in short. According to the website of the Ministry of Foreign Affairs[§], Denmark has been contributing "DKK 7.5 billion to support the fight against climate change, including DKK 2 billion from the Climate Envelope". This effort also contains support for research projects. The present research call consists of two application windows. DANIDA has two research windows. Window 1 involves five year projects with a maximum of 10 million Danish kroners. This particular call includes disasters and climate change research in developing countries as a very explicit thematic area (The themes are called Humanitarian Assistance and Development & Resilience to Climate Change in Window 1). In window 2, the focus is on growth and transition countries with many subjects closely related to disasters and climate change (for example- water governance; solutions o drought challenges etc). The target for DANIDA research funding is primarily on the global south. However, this also means that Danish universities and research institutions are financed through this call as lead applicants.

- The Danish Council for Independent Research (DFF) supports research in Denmark. According to this call, proposals are usually invited under any theme. In the online searches, we did not find any specific budget allotted for CCA or DRR research but it is an open competition of all thematic and faculty areas (Medicine; Social Sciences; Natural Sciences). Research is funded by way of large and small research grants; individual post-docs; international network grants etc. The Danish Council for Strategic Research under DFF has in recent years funded a number of climate/disaster relevant research projects mostly under the heading of sustainability.

- Innovations Fund Denmark (IFD): The IFD was created in 2015 by merging the Danish Council for Strategic Research; Danish Council for Technology and Innovation and the Danish National Advanced Technology Foundation. The IFD is focused towards financing investments in "applied research", "experimental development" and "demonstration & market development" (IFD 2015). Further, one of the research disciplines stated in the strategy of IFD is Energy, Climate and Environment. The IFD calls normally try to address societal needs with a high ambition to find solutions to problems identified in basic research.

1.4.2 Private or university funded research frameworks

[†] See Consolidation Act no 1189 of 27 September 2016.

[‡] See Consolidation Act no 121 of 26 January 2017 on the protection of the natural environment (*naturbeskyttelsesloven*)

[§] http://um.dk/en/danida-en/activities/strategic/green-growth/styrket-miljoe-og-klimaindsats-i-udviklingslandene/

Relevant private or university funded research frameworks include:

- Tryg Fonden supports projects that are related to the everyday lives of Danes to ensure long-range solutions[******************************]. Their projects take into account well-being of society at large that includes environmental; fire safety and flood related projects on the Danish coast.

- Velux:The Velux foundation supports inter-disciplinary research with a heavy environmental focus. Over the years, their investments in research has been growing in Denmark and abroad.[††††††††††††††††††††††††††††††] One example is that of a project for DKK 70,500,000 that focuses on *'A Sustainable Arctic Environment in a Changing Climate'*.

- KR Foundation[‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡]: This foundation was established in 2014 by Villum Fonden to fund research on primarily two program areas (Sustainable Behaviour and Sustainable Finance). These are areas closely connected to climate change.

- The University of Copenhagen's 2016 program for excellent interdisciplinary research launched in 2013 funds projects directly addressing disasters and/or climate change: The Changing Disasters project[§§§§§§§§§§§§§§§§§§§§§§§§§§§§§§] is one of them trying to explore answers to how societies change to growing disasters. A unique project spans across six different faculties at UCPH providing a platform for young and senior scholars to work beyond disciplinary boundaries. Further, the UCPH offers a one year Master degree in Disaster Management and a two year MSc degree in Master of Science (MSc) in Climate Change covering aspects of mitigation, adaptation and sustainability.

1.4.3 Relevant research organizations and networks

- Copenhagen Centre for Disaster Research (COPE)[*]: COPE is a cooperative network between University of Copenhagen and CBS to bring all disaster scholars in larger Copenhagen together as one network. COPE is part of the NORDFORSK-funded Nordic Centre of Excellence on Resilience and Societal Security (NORDRESS).

- University of Copenhagen's Sustainability Science Centre aims to facilitate and coordinate research on sustainability issues. Among the Centre's work, one of the areas is climate change issues.[†]
- Department of Environmental Science; Aarhus University (research on CCA): Another example of Danish CCA research is at Aarhus University. This department has been working on many projects concerning climate change adaptation. They also lead NORD-STAR[‡] - The centre for Nordic research on CCA. Further, research is being conducted on CCA integration and challenges at various municipalities in the Danish context.
- University College Copenhagen, METROPOL offers a undergraduate degree in disaster and emergency management, and employs research staff addressing issues of disasters and CCA.
- DEMA hosts an Emergency Services College and a Staff College. The aim of these colleges is to provide trainings and education in disaster preparedness. These are activities closely linked to DRR. These educational activities are usually for staff of DEMA and members working with emergency management at the municipality level.

The next sections will provide an overview of the methodology and present findings thereafter.

[******************************] https://www.trygfonden.dk/english
[††††††††††††††††††††††††††††††] http://veluxfoundations.dk/en/new-interdisciplinary-initiative-within-velux-fonden
[‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡] http://krfnd.org/program-areas/
[§§§§§§§§§§§§§§§§§§§§§§§§§§§§§§] http://changingdisasters.ku.dk/about/
[*] http://cope.ku.dk/
[†] http://sustainability.ku.dk/
[‡] http://envs.au.dk/en/about-the-department/sections/environmental-social-science/baeredygtig-energi-og-materialeanvendelse/nord-star/

2. Research methodology

For the study, a detailed literature search and review was conducted based on research conducted in Denmark on CCA and DRR. Further, official documents were used as sources for this study. Sources used to gather these materials were Google scholar; the Royal Danish Library's search engine REX; and websites such as Climate Change Adaptation Denmark and the Danish Emergency Management Agency (DEMA).

Keywords used to find literature in the context of Denmark include:

- Climate change adaptation; Disaster Risk Reduction; flood management; risk reduction; disasters; risk assessment climate; climate mitigation; disaster mitigation; interdisciplinarity climate change; communicating climate adaptation.

Denmark was used as a suffix to all the keywords while searching for literature. Further, additional literature was reviewed using the snow-balling approach based on references of reviewed literature. Similar key words identified above were used to review the documents.

For the purpose of this report, Denmark is treated as a case study. Case studies are used to provide detailed knowledge about a case in context (Yin 2000). Semi-structured interviews were conducted with key stakeholders in Denmark working with various aspects of DRR and CCA. Eleven interviews were conducted with 12 respondents (one interview had two respondents). In order to identify respondents- three major categories were used- Public; Private (including NGOs) and Academia. In the respondents were four academics (of which one is a part-time practitioner; one consultant; one who has previously worked with a municipality in CCA aspects); three/four interviews with public officials; and four interviews with private stakeholders (One NGO; One training private think tank on CCA; one respondent from Vejle). The interviews lasted from approximately half an hour to forty minutes each. An important criterion was to get an overview of the national context. Further, two cities of different scale were used to capture differing scenes in CCA and DRR. The cities identified were Copenhagen and Vejle. Copenhagen has been working very actively on the CCA and mitigation side and also on many global networks. Vejle is part of the Resilient Cities campaign has been working on the same issues. Although this is not a comparative study, it helps to capture two completely different views and approaches. The study will not present these differences as a comparison or as an evaulation but merely an analysis of various approaches/projects in the country.

For the literature identified, different pre-identified themes were used to pick the right material and also serve as themes for analysis. Policy documents and fact sheets used were analysed (Bowen 2009). The policy documents present an idea of background and current assumptions and trends within the government about the question in context. The interviews were recorded and parts of the interviews were transcribed as required based on the identified themes. The data is presented in the findings section below. As the number of interviews were small, no software was used for data analysis. For the coding process, categories were pre-identified (Kvale and Brinkmann 2008). The interviews and the selected literature for analysis were coded for the identified themes listed in the findings section (Institutional barriers; funding; political will; legal issues; governance etc). The findings and analysis is presented in the following sections. Finally a discussion is presented where different thematic areas are brought together.

3. Findings and Analysis

3.1 Challenges/Gaps related to GOVERNANCE in the existing legal/policy and science approaches

3.1.1 Institutional Barriers

Public and private institutions play a key role in DRR and CCA. In this regard, in 2012, the Minister for Environment, invited various stakeholders to dialogue and advise the Ministry on possible solutions to the challenges of climate change (Taskforce on Climate Change 2012:7). The findings of the study indicate that there has not been much discussion on integration. One of the respondent also identifies that suddenly words like CCA gets into the same league as disasters (for example- during the December 2016 flood) but not much is happening at the strategic level to bring this together.

Most of the respondents to our study highlight that government structures are very much working in silos. The various government departments are organized around a specific set of laws and budgets (financial structures). One of the respondent notes that Denmark has a "well-functioning bureaucracy" but it is hard to cut across the existing silos. The findings also point out that it may be easier working in smaller municipalities as people may know each other. This makes it easier to break barriers or to communicate and exchange on what is going on between urban planners; architects; technical and non-technical departments. However, activities in one municipality may affect the neighboring municipalities. In this context, it is worth mentioning that it may be extremely difficult to work across boundaries between municipalities. Interviews highlight that this is due to no existing guidelines to be able to work across boundaries. However, the study highlights that it may be extremely crucial to work cross-boundary between municipalities. The DRR agenda is primarily implemented at the national level and the CCA at the municipal level. In this context, one of the respondent mentions that municipalities have been good at making CCA an important agenda. The findings do not highlight if this has been a deliberate attempt to work towards CCA over DRR. However, as highlighted earlier, with the responsibility of CCA lying with the municipalities, there have been stronger initiatives in making CCA an important agenda at the local level.

All the municipalities make climate change plans but that does not necessarily include the emergency management organisations. The national governments support initiatives of local climate change planning by bringing in experts to discuss possible solutions. Further, the findings also indicate that municipalities need to make adaptation plans but it is very unclear on making necessary action plans for the strategies identified. Coordination of these action plans becomes crucial between different municipalities. There is great complexity in understanding private citizen responsibilities in addressing CCA. The municipalities facilitate the process of citizens taking responsibilities but this is seemed to be a challenging task.

In a survey conducted in 2012; it was shown that institutionally CCA lies mostly in technical departments and inclusion of other administrative departments is minimal. "The survey shows that inclusion of other departments is more common in larger municipalities than in small municipalities while this pattern is not strong enough to be statistically significant" (Jensen et al. 2016:59). While there are no deliberate attempts that are seen to integrate actions of DRR and CCA, it may be concluded that they continue to remain separate agendas. There are no converging institutions to do this nor are there any legal frameworks to assist in integration. This is also due to the fact that Disasters and CCA are mandates of different entities that work completely independent of each other. There are many initiatives for DRR and CCA that seem to have unclear boundaries but these seem to be ongoing without any formal integration attempts. Institutionally, emergency management and climate issues are agendas in different ministries. The emergency management including risk reduction is institutionally based in the Ministry of Defence, while CCA are based in the Danish Ministry of Energies, Utilities and Climate. Finally, the flood directive is implemented by the Danish Coastal Authority that is under the Ministry of Environment and Food. These agendas and mandates are placed in different ministries as in many other parts of the world. However, what needs to be done is to reduce institutional complexity and avoid bureaucratic arrangements that may hinder joint-collaborations and integration of CCA and DRR activities.

In Denmark, it is the municipalities, with the wastewater supply companies, that has the main responsibility for implementing climate change adaptation plans and strategies. A report from 2016 shows that there is a big difference in how far ten different municipalities (where the study was conducted) have come into their implementation efforts. Where some has finished the first major plans, other are just in the start-up phase of implementing concrete projects, while others are still in the process of mapping the necessary knowledge needed for decisions and plans to be made. In Denmark, it is water and flood management that's in focus when it comes to CCA, where the main challenges identified have been securing a sufficient knowledge base for efficient and lasting investments in CCA in Denmark, as well as incorporating CCA in the daily operations of the municipalities and supply companies (Lund 2016). According to the report, the municipalities and supply companies experience the most challenges with the regulatory frameworks, which are perceived as unnecessarily bureaucratic, inaccurate, absent or poorly coordinated. They point towards the importance of good cooperation both internally in the municipality, as well as across municipalities and supply companies for successful implementation of planned CCA projects. Involvement of citizen and landowners with local knowledge is also stressed as a crucial point; and informants of the report mention especially good results on CCA projects when citizens have been involved (Lund 2016).

1.1.2 Funding

The civil protection agency and general DRR-efforts are funded through a political accord, traditionally spanning a few years, but in the last couple of years agreed on a yearly basis. Based on a larger external audit of the Danish Civil protection system, a number of cutbacks have been implemented in recent years (Deloitte Consulting 2012). Few private funding opportunities are available, but some stand-alone initiatives on e.g. fire prevention have been funded through foundations such as the foundation TrygFonden.[§]

CCA efforts are funded under a more complex funding structure. As CCA remain closely connected to construction and city planning in the Danish context, municipalities through public investments provide the main funding (Hellesen et al 2010). This funding is often embedded in private-public partnerships or infrastructure investments. The municipalities have had a number of attractive regulatory incentives, placing climate investments outside the scope of the normal budget restriction on new construction projects – these have, however, been subject to change and discussion in recent years (Sørensen 2016).

Furthermore, in order to incentivize municipalities to engage in CCA efforts, the government as well as private foundations have funded a number of central initiatives. The Foundations Realdania, LOA ("Lokale- og anlægsfonden"), and Nordea e.g. supports projects focusing on urban development and CCA.[**] However, also entirely public government pools are available (in competition) organised either directly under ministries (e.g. under the Danish Transport, Construction and Housing Authority[††]) or as foundations (like the Innovation Fund Denmark[‡‡]). Worth of particular mention in this context is perhaps the Danish Green Investment Bank offering attractive funding as loans for projects with a distinct positive environmental foot-print.[§§]

Overall Denmark, comparatively seen, has been doing well with regard to climate mitigation and climate policy (Burck et al 2016). This is not possible without having funding made available. It is also important to note that private actors are often crucial to effective adaptation and mitigation efforts. Some initiatives that is worth mentioning includes the Ministry of the Environment's grant of DKK 2.7 million to eight projects in which local collaboration partners create solutions for climate change adaptation and investments in green growth (Task Force for Climate Change Adaptation 2012). It is identified that it is crucial to have private players involved in climate change planning as they co-finance projects along with the internal funding that is available (Cashmore and Wejs 2014). This is not free from problems- for example, these actors do not necessarily have an overall inclination to finance initiatives focused on safeguarding common, future goods. In a study conducted in Jutland in Denmark, it was noted that "the Port of Thyboron basically sees itself as a private enterprise with no formal responsibility toward climate adaptation and mitigation of the town of Thyboron" (Sørensen et al. 2016:17). In another study on climate related initiatives, it was noted that "the local industries in Soenderborg have been successful in providing legitimacy for the municipality supported by the fact that the industries also took the initiative to establish a financial foundation for the work" (Wejs 2014:1029).

[§] See more at Foundation's webpage: https://www.trygfonden.dk/fokus/sikkerhed/forebyg-brand

[**] A full overview of municipal funding options in Danish are available here: http://www.klimatilpasning.dk/kommuner/tilskud-til-klimatilpasning.aspx

[††] See more at https://www.trafikstyrelsen.dk/EN.aspx

[‡‡] See more at https://innovationsfonden.dk/en

[§§] See more at http://gronfond.dk/en/om-fonden/

The funding scenario is not free from operational challenges. One of the respondents mentioned that it is extremely difficult to understand the funding mechanisms and financial structures. A lot of the solutions in Copenhagen seem to be funded by utility companies. One of the respondent argues that it is equivalent to talking business all the time as it boils down to funding. The majority of the respondents identified that CCA funding comes from taxes paid by citizens. This is the budget available to the municipalities. It was also identified that, there is no department specifically for DRR as most of the organisations work in disaster response. Finally the interviews show that it has always been a challenge to transfer funds towards sustainability. The recent January 2017 flooding showed that investments in good planning and DRR helps reduce impacts in comparison to the previous floods. In a survey on CCA in Denmark it was found that "Even though the municipalities report to expect to have to make large investments in preventing damage from climate change impacts, it is still only less than one in five municipalities that involve the economic departments of the municipal administration in the work with adaption." (Jensen et al. 2016:59).

3.1.2 Political will/Motivation

There is enough consensus in research on the need for political will (Raju and Van Niekerk 2013). One of the respondent identifies that the CCA and DRR narrative is about creating a holistic approach. However, for this, decision makers need to know how serious the problem of disasters and climate change is.

Further, our study identified that political will is usually reactive in nature. To support this, one of the respondent mentions immense focus on economy and reducing funding for emergency related activities. Accordingly, the study also finds out that the attention paid to long-term planning is not sufficient. Further, much needs to be done to grasp this complexity of long-term planning. In the literature, at the political level for CCA it is suggested that "an obstacle to coordination across departments and therefore an obstacle to deeper integration of climate adaptation policy with other issues is a lack of a cross-cutting political committee with a budget" (Jensen et al: 2016:47). This may have a huge influence on the kind of decisions politicians are able to make with regards to CCA and DRR.

The city of Vejle for example is taking a different approach to overcome these challenges. CCA is seen as a societal challenge and learning how to approach shocks and stresses. The resilience team at Vejle has been trying to link these challenges to making new opportunities for the city. This is also reflected in the interviews in Copenhagen that there is sufficient will to address issues of climate change.

One of the respondent states "We need to make it a positive agenda. If we make it sound as a potential disaster, it makes it a bad business case in the political context. So the shift is to make this a discourse of how to develop more urban spaces with quality."

There seems to be a substantial attention to cities that increase livability. The budget required for DRR is expensive. An event such as the Copenhagen flood attracts attention. Further, one of the respondents notes that-while there are new perspectives on risk, there have been major cutbacks in funding as well. There has been a trend of pushing the entire responsibility towards the citizens.

However, literature also suggests the challenge of decision-makers in addressing problems with uncertainty (CCA) (Klein and Juhola 2014). Having said that, it does not discount the fact that long-term sustainable solutions needs to be a way forward for DRR and CCA. Denmark is considered to set standards globally with regard to climate mitigation and energy related projects. However, more needs to be done politically for CCA and DRR integration.

3.1.3 Stakeholder complexity

There are many initiatives happening at different levels in the country that facilitate stakeholder engagement. One of the respondent mentions that it is worth looking at the city as a whole instead of separate projects. Although the example cited here is from one city, it may be applied to broader settings at the national level as well. This calls for a systems thinking approach to integrating DRR and CCA. The approach is to have a common understanding of risk and take all stakeholders as co-creators of designing solutions to climate change. This is to benefit from tacit knowledge that is generated in this process.

The study also finds that one of the challenges of working with multiple stakeholders is the funding arrangement. The funding for CCA lies within the municipality and the work of one municipality can affect the other. However, a few respondents mention there is not much collaboration between different municipalities with the exception of few instances.

The Danish Red Cross notes that they are not part of the preparedness plan but more of a volunteer approach. In acute response and recovery, the Danish Red Cross has been intervening in the recent past as there was a need for psychosocial care. Similarly, responding to the migrant crisis. Now there is increasing awareness that the Red Cross can play an active role at the national level. Also, this highlights that volunteers are increasing in the context of disasters. That may be an unresolved issue if they are considered stakeholders.

This drives home the fact that there are both public and private stakeholders. We see an increasing interest from many different stakeholders in DRR and CCA. In Denmark, many utility companies; growing number of think tanks; academia; are all now engaged at various levels of CCA and disaster related activities.

For CCA, the stakeholder complexity factor is increased as the "sectoral division of local government presents an institutional barrier as offices not directly charged with climate adaptation responsibilities have paid little attention to the issue even when opportunities for integrated planning might exist" (Jensen et al, 2016:48). Within the CCA and DRR realms individually, there is a sufficiently complex web of stakeholders. In the current discussion of integration one can only imagine a challenging task of navigating this complexity. However, this is a much needed step in understanding complexity of stakeholders and their mandates. Klein and Juhola (2014) suggest the application of actor-oriented theory to adaptation research to understand stakeholder complexity. This may serve a useful tool in the context of integration of DRR and CCA given the varied range of stakeholders involved.

3.1.4 Procedural Gaps and Legal Frameworks (Trans-boundary)

Denmark has a number of regional arrangements on trans-boundary crisis. By a change to EMA in 2016 the deployment of foreign emergency management agencies was also given legal basis in Danish law.[***] However, already in 1989, the so-called NORDRED agreement (*Nordisk Redningsoverenskomst*) between Finland, Iceland, Norway, Sweden and Denmark was signed. The agreement enables all the signatory partners to request assistance in case of an emergency.[†††] In the Haga declaration[‡‡‡] from 2009, the ministers of defense declared a willingness to develop, among other things, a common Nordic emergency response unit; however no operational result has yet come out of it (Nordic Council 2010). Similarly, the so-called Stoltenberg report from 2009 suggests the establishment of a Nordic disaster task force under the NORDRED framework (Stoltenberg 2009). The report's recommendations are discussed on bi-annual meetings of the Nordic foreign ministers, and have resulted in a number of statements. While the Nordic countries seem to demonstrate political willingness to strengthen the cooperative and operational capacities of disaster management, no operative outcomes are yet in place.

In the 2011 Helsingfors statement[§§§] the Nordic Ministers made a declaration of solidarity, emphasizing "the strong community of values" between the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden). The declaration underlined the commitment of the Nordic countries "to cooperate in meeting the challenges in the area of foreign and security policy in a spirit of solidarity", and more practically to "upon request (…) assist with relevant means". The declaration will be followed up by an action plan suggesting practical measures, however it is doubtful if it can be considered more than merely a symbolic gesture in light of the obligations already undertaken through the European Union.[****] The European Union has experienced a vast expansion of its competences within disaster management – see separate report.

[***] See LOV nr 634 af 08/06/2016

[†††] See Nordisk Redningsoverenskomst article 3. See also Redegørelse af 11/10 16 om nordisk forsvars- og beredskabssamarbejde 2016. (Redegørelse nr. R 2), available at: http://www.ft.dk/samling/20161/redegoerelse/r2/1674681.pdf (last accessed Feb 2017) at 3.

[‡‡‡] Nordiskt ministermöte rörande samhällsskydd och beredskap, Stockholm 27 april 2009.

[§§§] See the Nordic declaration on solidarity.

[****] Iceland and Norway who are not members of the Union will now undoubtedly be included under the solidarity clause of the Treaty for the Function of the European Union, however both countries are participants to the Civil protection mechanism, which seems to be a more extensive scheme.

Within the health area, the Nordic countries entered into the so called *Nordisk Sundhedsberedskabsaftale* in 2002.[††††] The agreement contains a mutual obligation to assist in major health incidents in any of the signatory countries. Similarly, the heads of police have made an arrangement specifically addressing law enforcement issues.[‡‡‡‡] On a local level, the municipality of Copenhagen has an operative agreement with Räddningstjänsten Syd (The Fire and Rescue Service for the municipalities of Burlöv, Eslöv, Kävlinge, Lund and Malmo in Sweden) with a legal basis in the NORDRED accord. A similar arrangement specifically addressing the bridge across Øresund exists between Räddningstjänsten Syd and Tårnby fire department.

Denmark entered into a bilateral agreement with Germany in 1985 on mutual assistance on state level in case of major disasters.[§§§§] Furthermore, in the treaty on the establishment of a tunnel under the Femern belt from 2008, a specific provision addresses the cooperation on emergency management.[*****] Finally, a specific statutory order addressing the cross-border coordination with Germany[†††††] also exist with legal basis in the flood risk Act.[‡‡‡‡‡]

3.2 Challenges/gaps related to RISK in the existing legal/policy and science approaches

3.2.1 Risk Perception

Given the long coastline of Denmark, there has been increasing focus towards rising seawaters. It also started with events such as heavy rainfalls and cloudbursts. One of the respondent doing climate change research in Denmark a few years ago identified that public perception around that time (2010-2011) seemed to be low. Few of the respondents also highlighted climate deniers as a potential problem. Similar issues are seen world-over. For example, a recent article in the guardian by a climate scientist explains the need to battle against climate deniers (Hermann 2017). Respondents call for increased awareness on various risks. There is a perception that climate and weather is the same thing. This approach may be problematic, as the root of a certain event may not have been assessed.

In a study conducted on perceptions on CC in Limfjord area in Denmark, it showed very high climate change awareness among mussel farmers (Ahsan and Brandt 2014). A study in Lolland in Denmark highligths that all respondents in that municipality not only agreed climate change is happening but also that it will not change the everyday lives of citizens there (Baron and Petersen 2015). The study also shows that only home-owners who have experienced flooding have taken measures to reduce the impact of floods on their homes proving that experiences shape actions (ibid). The study concludes, that “in spite of living in a designated flood risk area, flood risk does not seem to play any major role in the everyday lives of the homeowners of Lolland” (ibid: 1154). In a survey on CCA in Denmark, it was found that the majority of the municipalities identified and recognized that CCA is a crucial cross-cutting matter for policy and planning (Jensen et al. 2016).

3.2.2 Risk Assessment

The Danish National Vulnerability Evaluation in 2004 brought about changes to the risk assessment sector. The risk assessment was divided into three phases- preparation, analysis and follow-up. The analysis phase is key- as it involves determining the scope of the analysis; identification of threats and create scenarios ; analysis of each scenario and compilation of risk and vulnerability profile. This model was updated in 2006. It may be fair to comment that threats in Denmark are more and more being seen as unpredictable. Also, the DEMA preparedness

[††††] See the agreement at http://www.norden.org/da/om-samarbejdet-1/nordiske-aftaler/aftaler/social-og-sundhedsspoergsmaal/nordisk-sundhedsberedskabsaftale (last visited Feb 2017)

[‡‡‡‡] Redegørelse af 11/10 16 om nordisk forsvars- og beredskabssamarbejde 2016. (Redegørelse nr. R 2), available at: http://www.ft.dk/samling/20161/redegoerelse/r2/1674681.pdf (last accessed Feb 2017) at 5.

[§§§§] Bekendtgørelse af overenskomst af 16. maj 1985 med Forbundsrepublikken Tyskland om ydelse af gensidig bistand ved katastrofer eller alvorlige ulykker. Available at https://www.retsinformation.dk/eli/ltc/1988/117 (last visited Feb 2017)

[*****] See Treaty on the establishment of a bridge across Femern Belt of 3 September 2008 art. 14, available at https://www.retsinformation.dk/forms/R0710.aspx?id=131195 (last accessed Feb 2017)

[†††††] Statutory order no. 1042 of 1 September 2010

[‡‡‡‡‡] See Consolidation Act no 1618 of 10 December 2015 (vurdering og styring af oversvømmelsesrisikoen fra vandløb og søer)

planning guide also stipulates that “calculations of future climate change” (DEMA 2009) must be taken into account for city planning. This guide is being updated in 2017.

A research project at the Danish Technical University (DTU) attempted “to coordinate research, data and models outputs between different research institutes from various disciplines” (Kasperson et al. 2012:35). This is for both- future projections on disasters (flooding) and also for climate change projections. According to one of the respondent, the risk scenarios made for natural hazards are not the agenda for action. There is not much relation to the activities implemented in the sector.

The study’s findings indicate that the majority of the work in this sector should be to identify which citizens are at risk. The risk approach needs to be an integral part of society. In this context, Vejle initiated a mapping to depict how a hundred year event would affect the city. This generated wide awareness about disasters (and effects of CC) being reality.

Further, at least a few respondents highlighted the approach taken by many agencies have a more technical focus and there is need for a more people-centric approach.

The Danish Meteorological Institute has been working towards better forecasting and to improve early warning systems. Some of the areas they have been working include storm surge modelling, remote sensing. These contribute to their work on emergency preparedness. There is always a discussion to take a more risk based approach to disasters. One of the respondent mentions the difficulty in having minor floods all the time. Further, also mentions the difficulty in not being able to draw patterns of how floods impact the city (it is sometimes driven by cloudburst, sometimes by storms or a combination).

The study notes that risk perception and assessment is connected to events- this is predominantly reactive in nature. Immense focus has been placed on cloud burst in Copenhagen although rising sea levels were equally a problem. This shift is happening now with regard to other potential disasters and impacts of CC.

3.3 Challenges/Gaps related to SCIENTIFIC FRAMEWORKS in the existing science approaches

The interviews highlight that there is a lot of potential for academia but there is not enough discussion to influence policy and political will.

The Danish government clearly stipulates the need for research on CCA. The strategy mentions “The government will therefore launch initiatives to promote:

• development of modelling tools for socio-economic evaluation of measures in the climate change adaptation area to the extent they do not already exist; and

• establishment of a coordinating unit for research in climate change adaptation that will create better coordination and knowledge-sharing of climate change adaptation research in Denmark and in relation to the rest of the world” (Danish Government 2008:12).

Research funding is available at different levels- ranging from public to private; EU and from other global institutions such as the World Bank. There tends to be a tendency to move from project to project creating a fragmented approach without synthesizing results relating to CCA and DRR coming from different research studies. Furthermore, academia remain too siloed as well. There needs to be innovation “to challenge the way we have done things and do things differently” says another respondent.

People within an organization have differing scientific traditions. It is often considered a challenge working between these boundaries. In this context scientific language becomes a problem as one concept may mean differently to different stakeholders.

One example provided by the respondents is that of an all engineering solution approach by utility companies while other stakeholders may have completely different approaches to tackle the problem.

Further, in urban areas there is a bigger tendency to cooperate more with departments of urban planning, social sciences is not a major part of the agenda for CCA. Further the study highlights that we need to be better at problem identification in this regard as Copenhagen was completely focused only on cloudbursts due to an event in 2011. A study on mapping climate research in Denmark in 2009 highlights that the majority of climate research (mitigation and adaptation) lies predominantly in the natural sciences (Ministry of Science, Technology and Innovation 2009). There is no data to show if that has changed as of today in Danish universities and research institutions. It is of utmost importance for crosscutting fields such as CCA and DRR to be promoted in natural, social and technical sciences.

3.4 Challenges/Gaps related to COMMUNICATION in the existing legal/policy aspects

Language plays a key role in generating awareness and action for CCA and DRR. Very interestingly, it was noted that resilience is not a common term used in the Danish language. Initially, when the resilience movement started, stakeholders were not very keen to take resilience on board. Now the concept of resilience is very much part of the Danish language on CCA.

One of the respondents' spotted a very interesting picture in the city of Copenhagen. This was in an area undergoing road works. The picture stated "working to secure buildings from climate change" (translated). This type of communication may not only increase awareness around the growing issues of CC but also create a responsibility on the part of the citizens to take initiative in protecting their property.

Another interesting aspect is the use of the word disaster. In Denmark, two of the respondents identified that- the word disaster (katastrofe in Danish) is rarely used. Usually, one would identify or use the name of a particular event (flood; cloud-burst; etc.). Accordingly, the word "katastrofe" plays little or even no role in the legal frameworks accounted for above.

At the municipal level, some of them have been very proactive on social media. In a recent situation, the Mayor was at the disaster site and communicating through social media.

Further, with regard to CC, involvement of the public is considered to be low. One of the respondent notes it as "pseudo-participation" and this could be improved. Our study also highlights that there is not enough discussion in academia to influence policy and political will.

There are initiatives that have unclear boundaries between CCA and DRR. For example, Vejle's Resilience Strategy states "Vejle is threatened by flooding so we must focus on protecting the city's assets and citizens, in particular our vulnerable citizens" (Vejle Kommue 2016:76). This clearly indicates a nexus between CCA and DRR. It is very clear that many efforts towards integrating DRR and CCA do ot necessarily use the same language. In Denmark, in our analysis we see that DRR is not a commonly used terminology.

3.5 Any other Challenges/Gaps in the existing legal/policy and science approaches pertaining to the key ESPREssO Challenges

There are many initiatives being taken in the city of Copenhagen and in Denmark widely that our respondents identified. One of them is the training of school children to be climate ambassadors in the country.

The study notes that DRR is not a concept everyone is familiar about. Risk concerning climate change is spoken about widely. In our interviews, we see that the majority of the stakeholders would respond to a lot of questions only from a CC perspective and not necessarily talk about DRR.

Further, the traditional emergency management sector is under a lot of pressure as it is being restructured. This is due to the changing nature of disasters beyond fires and accidents. That may also mean funding cuts and increased competition in the future.

Baron and Petersen (2015) argue that CCA is almost used as a synonym for food protection in Lolland in Denmark as the region has been indicated as a flood risk area in the EU Flood Directive report. However, according to one of the respondents- "there is a lot of tacit knowledge" in the emergency sector that could benefit CCA.

Crucial to the aim of the report is that of trans-boundary work in DRR and CCA. It is a challenge working trans-boundary- especially with language barriers. The EU is trying to make this work, however the respondent identifies that legal aspects are very different in both countries (for example Sweden and Denmark). The study also shows that there are historical and cultural differences in addressing disasters. Further, in the recent past the refugee crisis has taken more importance. However, it is shown that a common platform between nations for trans-boundary crisis management is not very evident. In this context, one of the respondents mentions that there is a need to focus on agility in working with disasters and CC.

Solutions may lie in linking different problems and coming with a multi-benefit approach. This is in line with integrating DRR and CCA.

4. Discussion

4.1 Governance

The findings clearly indicate that stakeholders are either working in silos or lack the tools to work beyond the boundaries of CCA or DRR (depending on the mandate and tasks of the organisation/department). This has been proven in other contexts in disaster recovery settings as well. It is extremely difficult to see different departments working across their mandates. There are no tools available to address this challenge except to increase collaboration between departments.

Accordingly, disaster risk reduction is not something only centrally imposed and maintained, but rather something inherent in all functions of the state. This also means that the regulation of and framework for dealing with disaster risk takes places in all sectors of state, and at all levels. When confronted with cross-sectorial hazards (e.g. foot-and-mouth disease) the management is coordinated at national level. When a major disaster necessitates state involvement or cross-sector hazards call for coordination between different sectors, a national crisis organization steps up to tackle the situation. At the policy level, "the lack of inclusion of adaptive issues in policy areas outside the technical and environmental department is a major barrier for developing comprehensive adaptation policies." (Jensen et al 2016:41).

While there may be different types of enabling environments for effective governance, it is identified in the interviews that it may be easier to communicate with each other in smaller municipalities. Further, institutions set up to address issues of CC and disasters are very different. While there may be converging factors between these two fields of work, it is extremely important to acknowledge the differences as well (such as the very nature of hazards that CCA addresses does not include the entire range).

4.2 Climate Change Adaptation and Mitigation

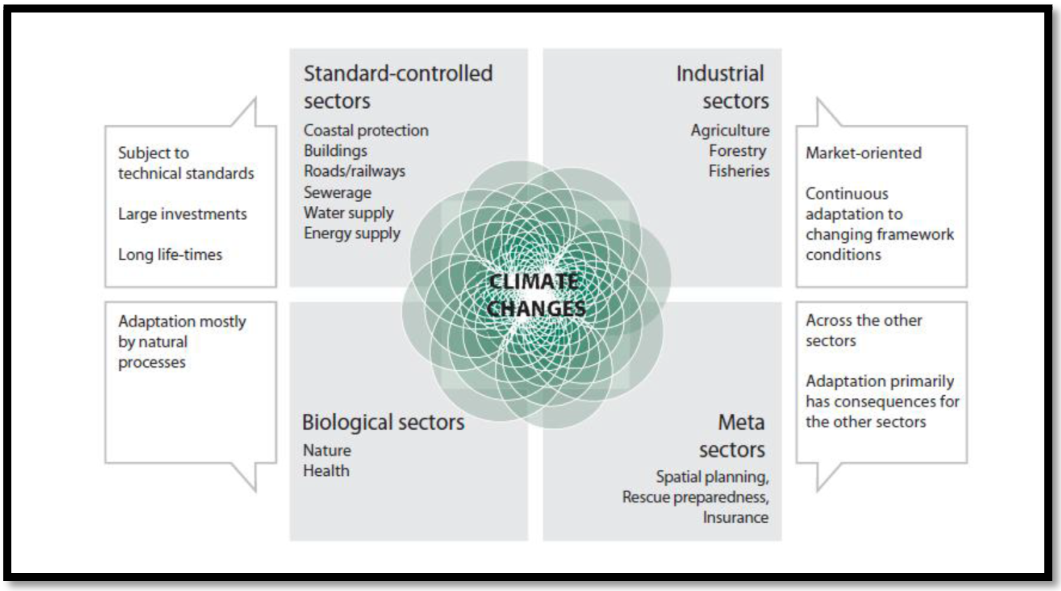
According to Adger et al (2005:78) adaptation is "adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities". This understanding of adaptation may be interpreted as having a close connection to DRR. However, adaptation research and DRR research seem to be two separate worlds. In the recent past, there is growing literature about the need for integration even across disciplines.

In Denmark, it is worth mentioning our study also showed increasing importance placed on climate mitigation. Climate mitigation is highly prioritised in Denmark, with production of sustainable energy being very successful in terms of wind power. There is work going on to keep Denmark's agenda in renewable energy. Further, for Denmark current challenges is to make reductions in the transport sector, and adopting technologies that reduce greenhouse emissions – this is expensive, and funds for this is currently lacking, and increased political will might be needed. The city of Copenhagen won the European Green Capital Award 2014. Copenhagen received this award for its urban planning and elements of public-private partnership[§§§§§]. Further, Copenhagen is also part of the C40 (network of cities addressing climate change). In this case, Copenhagen was given due credit for being bicycle friendly. This means that Copenhagen is being recognised for its efforts in climate mitigation. Also a peek into Denmark's State of Green presents a clear case of motivation towards urban planning and sustainability [******]. Here on the State of the Green are identified a few solutions Denmark has achieved and working towards CCA.

The findings indicate a crucial gap between mitigation and adaptation. There is very little conversation and collaboration between these two departments. While there is great potential to channel resources of time and capital into a common goal- there seems to be disagreement on a common goal. The study does indicate a substantial amount good work and efforts at different levels in Denmark. However, these forces and efforts combined could produce better results. Further, studies in Denmark show that disaster risk management does not

§§§§§ http://ec.europa.eu/environment/europeangreencapital/winning-cities/2014-copenhagen/
****** https://stateofgreen.com/en/profiles/state-of-green/news/12-examples-of-climate-resilient-city-solutions

get the same priority as CCA as highlighted by Sørensen and Jebsen (2015:9) “that there is no integration between DRM and CCA mainly because of the lack of interest towards DRM in contrast to CCA”.



Source: NIRAS 2010

According to a report “Adaptation involves the adaption of new construction projects, and maintaining existing buildings and installations, to the new climatic conditions” (NIRAS 2010:8). Further, the report identified cross-cutting themes for climate change. Among them are many areas of work that have close connections to DRR. For example- coastal protection is one such area that spans between CCA and DRR. However as highlighted earlier, these boundaries are either not negotiated or discussed. In the Danish context, the institutional barriers may linger on (as they take time to be negotiate and addressed) although it does make good case for integration as most natural hazards are climate related in Denmark. Acoording to a Danish report, the municipalities where climate adaptation is a part of their overall strategy, more efforts and projects are in progress, and better systems and procedures for CCA are in place. Staff in the municipalities furthermore reports that they are particularly motivated and pleased with projects that are holistic in nature and that creates value in the local society; such as urban renewal or recreational projects, instead of a sole focus on water management (Lund 2016).

4.3 Academia and Science

Klein and Juhola (2014) claim that adaptation research in the Nordic countries has gone up in the past ten years. However, this focus on adaptation research has not translated into policy (ibid; Preston et al. 2013). This may well be achieved by co-production of knowledge (Preston et al. 2013). In Denmark, although heavy focus in the climate policy is placed on the Climate council and the need for research- most of the research focus continues to be on mitigation. The “Danish strategy limits the government’s role to facilitating autonomous adaptation by other stakeholders” (Klein and Juhola 2014:105). This means that there is increasing responsibility for private stakeholders and municipalities to take added mandates for CCA. However, there needs to be a nexus between these stakeholders in order to arrive at policy conclusions. There seems to be a fundamental gap in bringing investments in CCA research to policy.

About DRR, a parallel research world takes over that necessarily does not work in collaboration with the CCA community. There is a clear need towards placing more focus on interdisciplinary approaches. There is a great deal of attention required to bring different research traditions to discuss and work on common research projects. Academia is not free from silos but also has not sufficiently involved in influencing policy towards integration of CCA and DRR.

There is far greater need to focus on scientific approaches and how these approaches can influence policy. At the various research institutions, research is generally restricted to within their own or closely related departments. There are very few exceptions on cross/trans/inter-disciplinary research agendas in this field in Denmark. Further, institutions are also part of research networks in the Nordic countries and part of many European Union research projects. However, there is little exchange of information, and thereby cross-fertilization, between these projects and initiatives.

There are also many other initiatives in sharing knowledge that have been started. One such is the Climate ambassadors (Klimaambassaden) program by Concito[††††††] where school children are made aware of issues of climate change. Children are used as powerful communicators of climate change issues to the Danish community. This way of using scientific spaces may be valuable to the sector.

There is certainly no doubt of lack of sufficient scientific frameworks for disaster risk reduction. Academia could be helpful in testing the relevance of such tools and providing evidence for improvements or modifications. On the other hand, there are risk analysis done for weather predictions and projections. This is the domain of completely technical scientists. In this context, there is no communication between the technical experts doing risk analysis and social scientists working with DRR and CCA. One of the major challenges identified by Klein and Juhola (2014) related to uncertainty associated with climate change. Decision-makers may not always see the potential benefits of making a long-term case in an uncertain problem statement. This ofcourse leaves a sense of frustration among the scientific community of being unheard or in limbo of not finding a common ground.

4.4 Mismatches

Birkmann and von Teichman (2010) identify several mismatches between DRR and CCA. The temporal scale is merely about the time scale of activities of DRR and CCA. In the case of Copenhagen for example, we observe immense attention to cloud burst related activities after a certain event in 2011. This is common with DRR as well-when an event happens. The nature of solutions and approaches is time dependant.

Functional mismatches are seen in activities of DRR and CCA placed with two different ministries. This is already presented in the findings in the section on Governance. Institutions working on DRR and CCA are different both at the political level and in academia. Further, even with private stakeholders, there are a number of actors focusing on different objectives of CCA and DRR.

Spatial scales are observed as well. While DRR/ all disaster related activities are carried out or placed at the national level, climate related activities are the responsibility of the municipality level. Klein and Juhola suggest that “There is a mismatch between the local scale on which many stakeholders operate and the smaller-scale climate information provided by models” (2014:105). This may mean that stakeholders are not in a position to work closely due to constraints of differing levels of action. Further, Jensen et al (2016) highlight that the size of the municipality makes a big difference in making decisions relating to CCA. This may be due to several reasons where one of them could be that “the national government while providing a rather flexible mandate and framework for local climate adaptation policy action represents a smaller barrier precisely due to its lack of leadership and guidelines” (Jensen et al 2016: 48).

Mismatches in Knowledge are seen as the study highlights the relevance of tacit knowledge that can potentially be used from the emergency sector for CCA. The question is therefore about- how to make sure all solutions become multi-benefit solutions? To make integration more successful, and thereby it may be useful to mobilise capital for CCA by making it a business case and thereby able to make multi-benefit solutions. Copenhagen as a smart city has been sharing experiences and insights on a more global scale. However, this knowledge is not seen as transferred to other municipalities within the country. There are signs of knowledge mismatches visible in literature in the Danish context. While there is immense potential and technical knowhow in the field of DRR and CCA, there seems to be a mismatch between bigger and smaller municipalities (Jensen et al 2016). The bigger municipalities have more access to planners and other technical capacities more than the others do (ibid).

Wamsler (2016:191) highlights that adaptation may be obstructed by citizens by “(i) not accepting institutional assistance or guidance, (ii) taking inadequate adaptation measures or (iii) demanding assistance for actions that are their own responsibility”. This may certainly be the case when there is insufficient communication between public authorities and the citizens. While in Denmark, it is shown that citizens also need to take responsibility,

[††††††] https://concito.dk/klimaambassaden

there needs to be increased communication channels between different municipality departments and the local citizens. On the other hand, municiplaities may obstruct adaptation of citizens initiatives by a lack of coordination with other institutional actors (ibd). Therefore, from the side of the governmental authorities it is necessary for coordinating between different institutions as highlighted in earlier sections.

5. Conclusions & recommendations

Denmark is favourably situated: geopolitically, geologically and climatically. Thus, Denmark has traditionally been shielded from the most violent meteorological hazards; is almost free of serious geological hazards; and has an overall friendly relationship to its neighbours. Accordingly, Denmark has the lowest expenditure (measured as procentage of the GDP) on public safety and order of any European country (see Eurostat 2017) and a 2012-report suggested that Denmark per capita only spends 3/5 that of Sweden and Norway (Lund 2012). While this might seem problematic, the country has developed and implemented a proactive and ambitious strategy on climate change, including through comprehensive adaptation measures in recent years.

However, this imbalance between the efforts dedicated to DRR and CCA, leads to a number of problems identified in this short country report:

There are many good initiatives that are seen in Denmark in the context of disasters and climate change. However, the challenge of *cross-sectoral learning* can be addressed by sharing knowledge and working together. This is not least the case with efforts anchored at the municipal level of governance, Although clearly CCA lies in the fold of the environmental affairs, there are overlaps and similarities to the actions being taken for DRR. These actions and policies need to talk to each other more to increase efficiency.

In spite of the comprehensive climate change focus, an *imbalance between mitigatory and adaptative meassures* remain. That is, presently main attention, funding and institutional backing is provided to climate mitigation over adaptation. Furthermore, the CCA efforts is anchored and implemented at municipal level, which in the longer term might raise issues of potential geographical imbalances, and potentially injustices.

Further, according to this study based on interviews and literature, there is no strict divide between mitigation; adaptation and DRR activities in terminology. Nonetheless, the organisational and legal responsibility for the central governance instruments are spread across a number institutions with significantly different mandates and compositions. Against that background, it may be useful to further *integrate DRR and CCA institutions*. Such an effort would make DRR and CCA more visible and necessary.

The *academic milieu* could do more to cross-fertilize and integrate knowledge, efforts, and strategic aims - both within and beyond the institutional set-up in Denmark, including bridging the gap to the respective professional environments. Similarly, the professional organisations responsible for DRR and CCA in Denmark could do more establish this link.

According to the Progress report of the Hyogo Framework for Action, Denmark seems to have achieved substantial progress in DRR and CCA. The report clearly highlights that all efforts of DRR and closely connected with CCA given the nature of hazards affecting Denmark. The progress also indicates that immense progress was shown in legislations and creating institutions to address these issues of climate and disasters (DEMA 2015). However, these are not completely free from challenges. The progress report clearly demonstrates the need for closer collaboration between emergency management actors working on DRR and the climate community working on CCA. This established nexus could prove to be a successful collaboration with sustainable results in the long-run.

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